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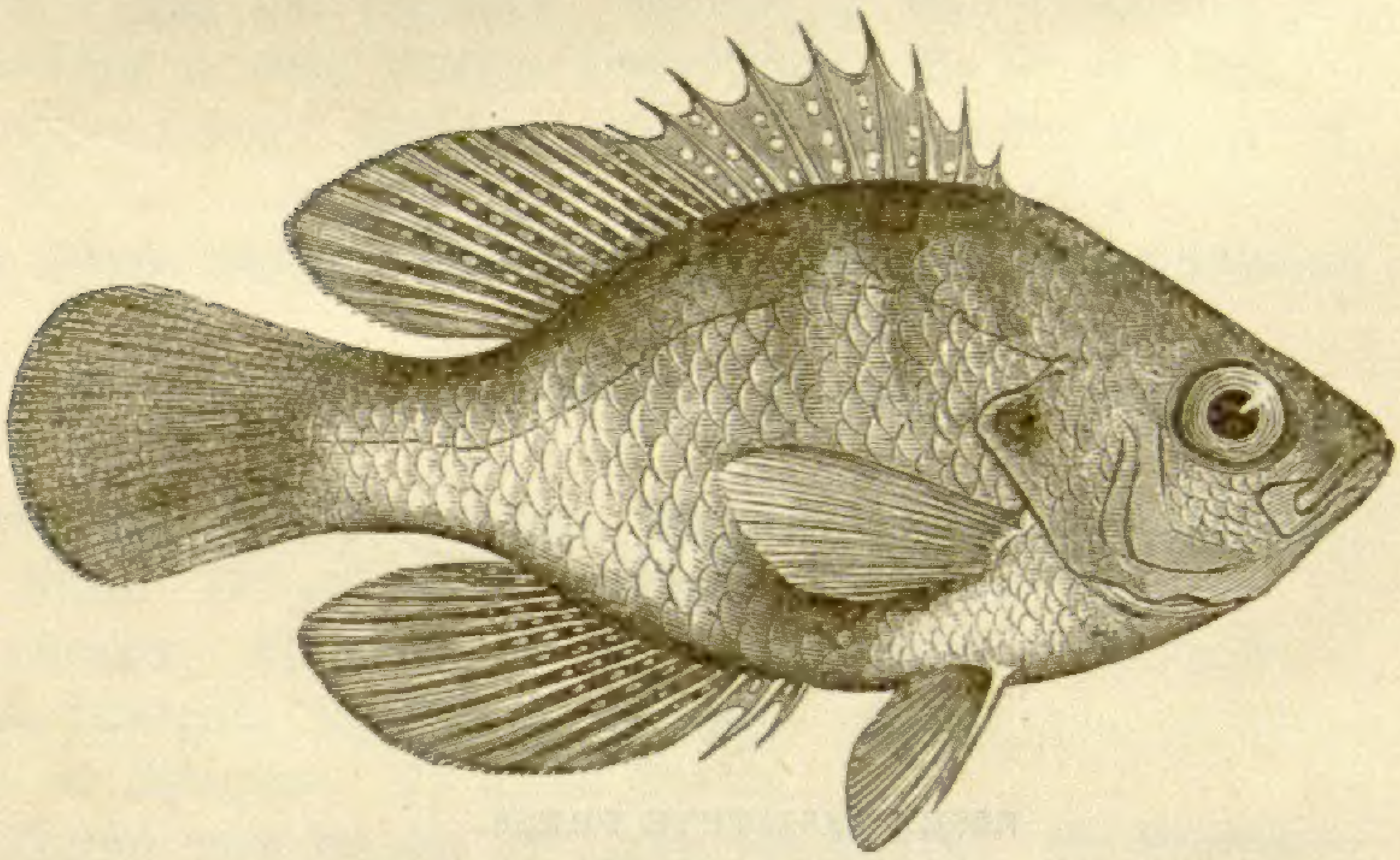

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ERRATA.

ERRATA TO VOL. IV.—Page 63, line 16, for *pervenum* read *perversum*. Page 30, line 15, for *lips* read *hips*. Page 36, line 2, for *Arctostaphylla* read *Arctostaphyllos*. Page 103, line 9, for *H. analostanus* read *H. Kentuckiensis*. (Later, however, Cope has shown the species to be *distinct from* Kirtland's *Kentuckiensis*.) Page 117, line 13 of foot note, for *Teretribus* read *teretulus*. Page 112, line 16, for *Rariton* read *Raritan*. Page 273, the sentence beginning on line 9, should begin, "Now it is not often the case." Page 316, line 6, for *mouth* read *mantle*. Page 439, line 3 for *but one*, read *an*. Page 439, line 3, leave out the word *but* before *one instance*. Page 458, line 21, for *Lord Mondoddo* read *Lord Monboddo*. Page 468, line 7, for *it is* read *is it*. Page 468, line 13, for *possession of stars* read *procession of stars*; and in line 14, for *either* read *ether*. Page 501 under figure 100, first line, for *Apus* read *Branchipus*, and in second line, for *Branchipus* read *Apus*. On line 1 from bottom, for *cephalothorax* read *head*. Page 126, last line, for MR. DRESSER read MR. DRESLER. Page 375, line 34, for J. P. KIRKLAND read J. P. KIRTLAND. Page 651, last line, for *Zoologist* read *Zoologists*. Page 689, line 29, for *poisoning* read *poison ivy*.

Plates 3 and 4 (pp. 490, 491) should read plates 4 and 5. Plate 5 (page 637) should read Plate 6, and Plate 6 (page 687) should read Plate 7. Page 572, for figure 100, read figure 114. Page 575, for figure 100, read figure 115. Page 700, for figure 140, read 157. Page 701, for figure 141 read 158. (These corrections, however, only refer to the serial numbers of the plates and cuts, as the references in the text are to their present numbers.)

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THE PRIMEVAL MONUMENTS OF PERU COMPARED WITH THOSE IN OTHER PARTS OF THE WORLD.

BY E. G. SQUIER, M.A.*

THERE is a class of stone structures in Peru belonging to what is regarded through the world as the earliest monumental period, coincident in style and character with the cromlechs, dolmens, and "Sun" or "Druidical" circles, so called, of Scandinavia, the British Islands, France, and Northern and Central Asia. The existence of such remains in Peru has not, I believe, been hitherto mentioned by any traveller in that country. They are not very numerous, at least not in the parts of Peru traversed by me, but their scarcity is probably in great part due to circumstances and causes to which I shall refer further on, and is by no means inconsistent with the supposition that they formerly existed in considerable, if not very great numbers.

I think students will attach importance to these remains as indicating the existence at one time or another in Peru of a population identical in degree and stage of development with the people who raised corresponding lithic and megalithic

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monuments in other parts of the world, and who, if not the progenitors of the semi-civilized nations found in Peru at the time of the conquest, certainly preceded them in the occupation of the country. If it should be found, nevertheless, that there has been a gradual development of any of these rude remains into elaborate and imposing monuments, corresponding with them in their purpose or design, or a gradual change from the rough burial chamber of uncut stones into the symmetrical sepulchral tower built of hewn blocks accurately fitted together, and in general workmanship coinciding with the other and most advanced and admirable structures of the country, then we may reasonably infer that the latter were constructed by the same people that built the first, and that, monumentally, at least, the civilization of Peru was indigenous, gradually developed and not intruded. Leaving, however, the very few and obvious deductions I may feel justified in making, for the close of this brief paper, I wish to call attention to three groups of monuments, the *chulpas* and other remains of Acora, Quellenata, and Sillustani, all in the great terrestrial basin of Lake Titicaca, near that lake, in that political subdivision of the ancient Peruvian Empire called the *Collao*, and now Department of Puno.

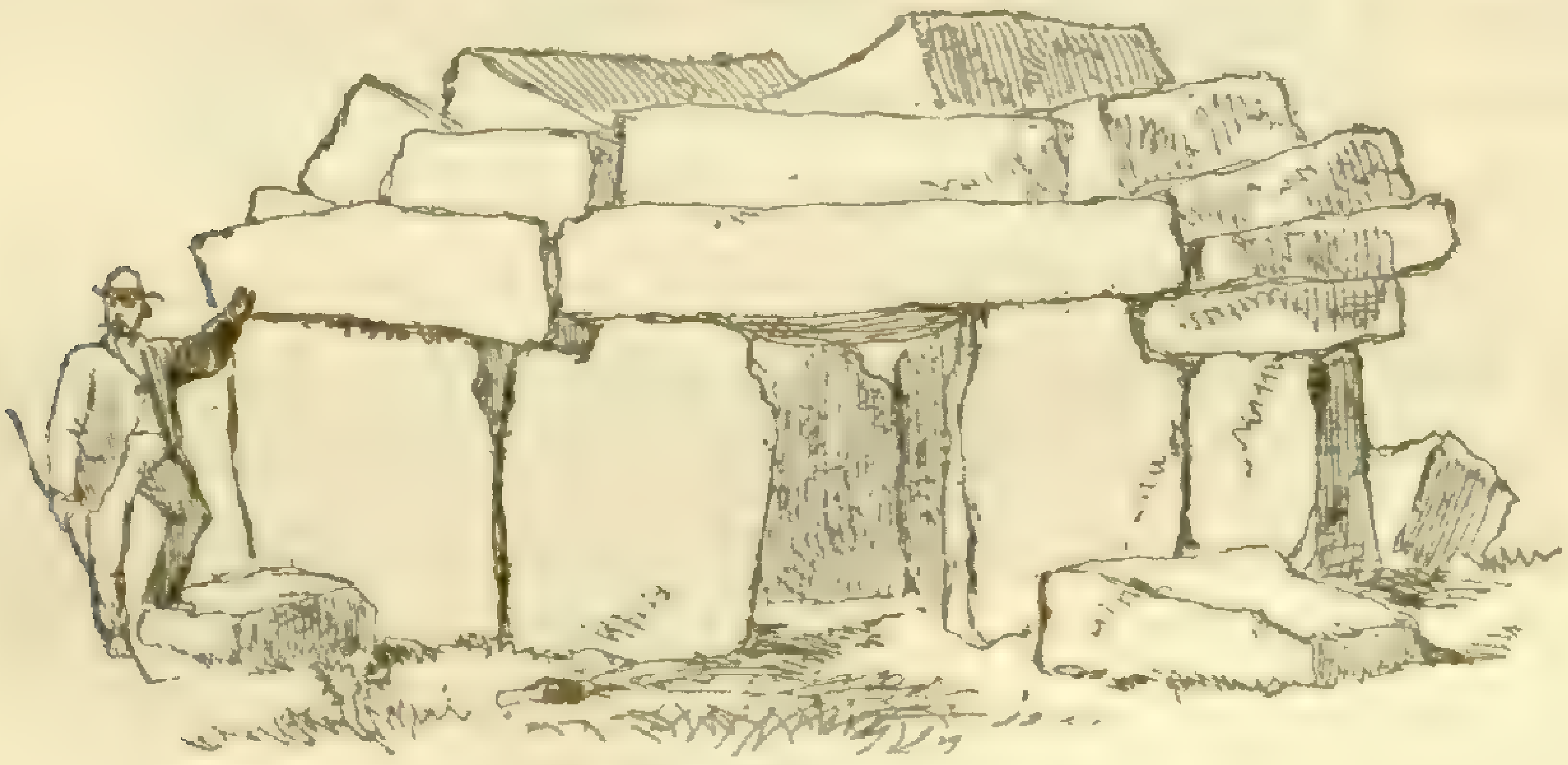
The arable portions of Peru, circumscribed by mountains, cold and sterile *punos* or table-lands, and bare deserts, early forced the population of the country to a close economy of their cultivable lands, and led them to bury their dead and build their towns in waste places, on arid hillsides above the reach of irrigation, or on rocky eminences and promontories, which even their patient industry could not make productive. In such positions throughout the ancient Collao, we find numberless cemeteries, often in proximity to the ruins of towns and villages. Some of these cemeteries are marked by really imposing monuments, and form conspicuous features in the landscape.

The first and simplest form of the burial monument, and which I shall assume, for the present, to be the oldest, con-

sists of flat, unhewn stones of varying lengths set firmly in the ground, projecting above it from one to two feet, so as to form a circle, more or less regular, about three feet in diameter. The body was buried within this circle, in a sitting or crouching posture, and with a vase of pottery or some other utensil or implement at its feet. Sometimes a few flat stones were laid across the upright ones, so as to form a kind of roof, and in a few instances these rude tombs were placed side by side in long rows, and stones afterwards heaped over them, so as to give them the appearance of lines of ruined walls.

Another rude but more advanced and impressive form of

Fig. 1.



Primitive Tomb, Acora.

the tomb consists of large slabs of stone, projecting from four to six feet above the ground, and also set in the form of a circle or square of from six to sixteen feet in diameter. These uprights support blocks of stone, which lap over each other inwardly, until they touch and brace against each other, thus forming a kind of rude arch. A doorway or opening is often found leading into the vault, formed by omitting one of the upright stones.

The arid plain to the south of the town of Acora, near the shores of Lake Titicaca, and twelve miles distant from the ancient town of Chucuito, is covered with remains of this kind, of which Fig. 1 is an example; and on the western border of the plain, at the base of the mountains which

bound it in that direction, are some of the better class of *chulpas*, round and square, built of worked stones, to which I shall have occasion to allude in another place.

A modification of the second class of *chulpas*, which I have described, or rather an improvement on them, is to be found among the ruins, so called, of Quellenata to the northeast of Lake Titicaca, in Bolivia (Fig. 2), and at many other places in the ancient Collao. Here the inner chamber or vault is formed, as in the case of those already noticed, by a circle of upright stones, across the tops of which flat stones are laid, forming a chamber, which often has its floor below the general level of the earth. Around this chamber a wall is built, which is carried up to varying heights of from ten to thirty feet. The exterior stones are usually broken to conform to the outer curve of the tower, and the whole is more or less cemented together with a very tenacious clay. Nearly all are built with flaring or diverging walls; that is to say, they are narrower at their bases than at their tops. Sometimes this divergence is on a curved instead of a right line, and gives to the monument a graceful shape. In Quellenata I found only one skeleton in each of the *chulpas* I examined; and none of the *chulpas* had open entrances. Similar structures in shape and construction occur in great numbers among what are called the ruins of Ullulloma (Fig. 3), three leagues from the town of Sta. Rosa in the valley of the river Pucura. But here the *chulpas* have openings into which a man may creep, and all of them contained originally two or more skeletons.

Returning now to Acora. As I have intimated, within sight of the rude burial monuments already noticed as existing there,—and which so closely resemble the *cromlechs* of Europe,—are other sepulchral monuments, showing a great advance on those of Quellenata and Ullulloma. They are both round and square, standing on platforms of stones regularly and artificially shaped, and are themselves built of squared blocks of limestone. In common with the primitive

Fig. 2.

Pucura, or Hill Fortress of Quellenata, with Chulpas.

and typical forms of the same class of monuments already described, these also have an inner chamber, vaulted by overlapping stones, after the fashion of the earlier approximations towards the arch. They differ, however, in having each four niches in the chamber or vault, placed at right angles in respect to each other. The sides of these niches converge a little towards their tops, as do most of the Inca niches, windows and doorways. In these niches were fastened the bodies of the dead, in squatting or crouching postures.

Fig. 3.

Chulpa, Ullulloma, partly ruined.

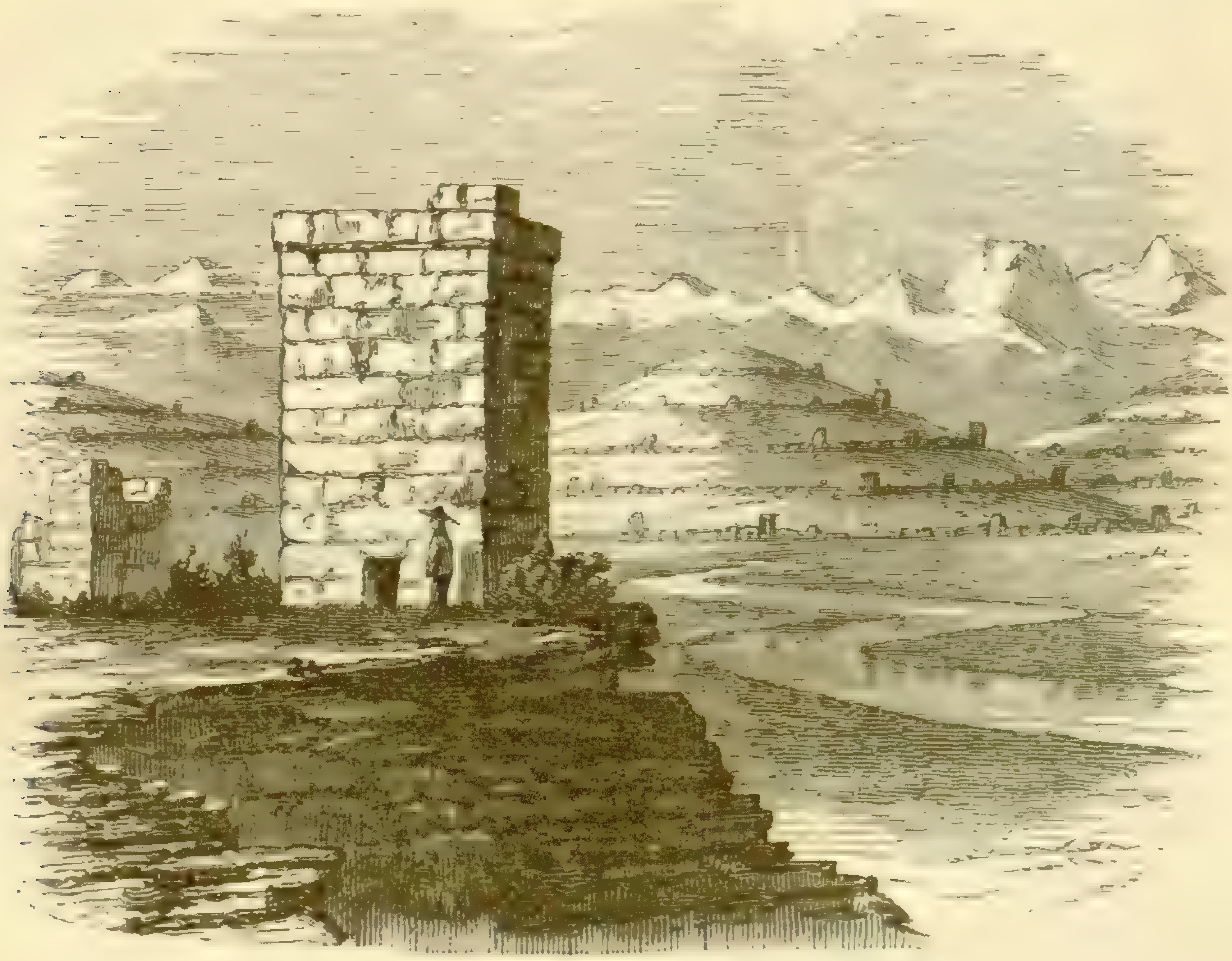
Figure 4 is a view of a double-storied, square *chulpa*, with a *pucura* or hill fort in the distance, occurring near the Bolivian town of Escoma, on the eastern shore of Lake Titicaca. Figure 5 is a section of this *chulpa*. I introduce these cuts to show some of the variations in this class of monuments. Escoma is on the same side of Lake Titicaca with Quellenata, but sixty miles to the southward; and it is a curious fact, that while at the latter place all the *chulpas* are round, at the former they are all square.

The sides of all the square *chulpas* appear to be perfectly vertical, and near their summits we find a projecting band or

cornice. Their tops seem to have been flat. On the other hand the round *chulpas* here swell out regularly up to the ornamental band or cornice, and terminate in a dome.

These features, however, are still better marked in the ruins of Sillustani, where the *chulpas*, in respect of size, elaboration of design and workmanship, take their highest form. Here we find them built of great blocks of trachyte and other hard stones, fitted together with unsurpassable

Fig 4.



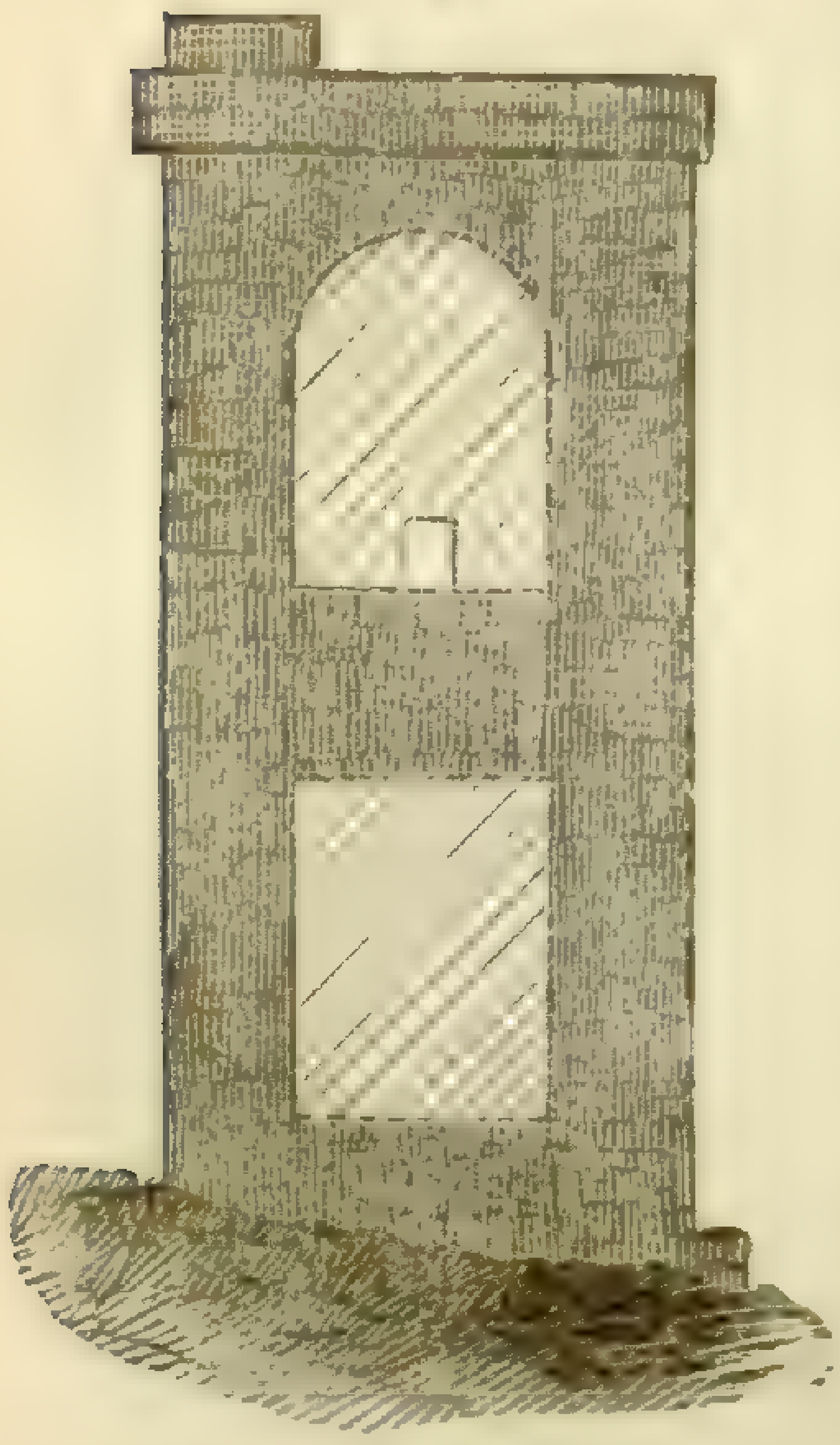
Square Chulpa, Escoma, Bolivia.

accuracy, the structure nevertheless preserving some of the characteristic features of the first and rudest form of the *chulpa* (Fig. 6). The lower course of stones is almost invariably composed of great blocks of which the unhewn portions are set in the ground, and these support a series of layers, not always regular in respect of thickness, nor uniform in respect of size, but which have their sides cut on exact *radii* of the circle, and their faces cut with an accurate bevel upward to correspond with the swell of the tower.

The stones forming the dome are not only cut on accurate radii, but the curve of the dome is preserved in each, and they are furthermore so cut that their *push* or plunge is inward towards the centre of the structure, thereby tending to give it compactness and consequent strength. There are many other interesting architectural features connected with these remains of Sillustani, the enumeration of which is not necessary in order to illustrate the particular question before us.*

Some of the *chulpas* of Sillustani have double vaults or chambers, one above the other, and others have a double row of niches, in a single chamber, with a cist, carefully walled up, sunk in the earth below. There are a few built of rough stones plastered and stuccoed over, and painted, with inner chambers also stuccoed.

Fig. 5.



Section of Chulpa (fig. 4).

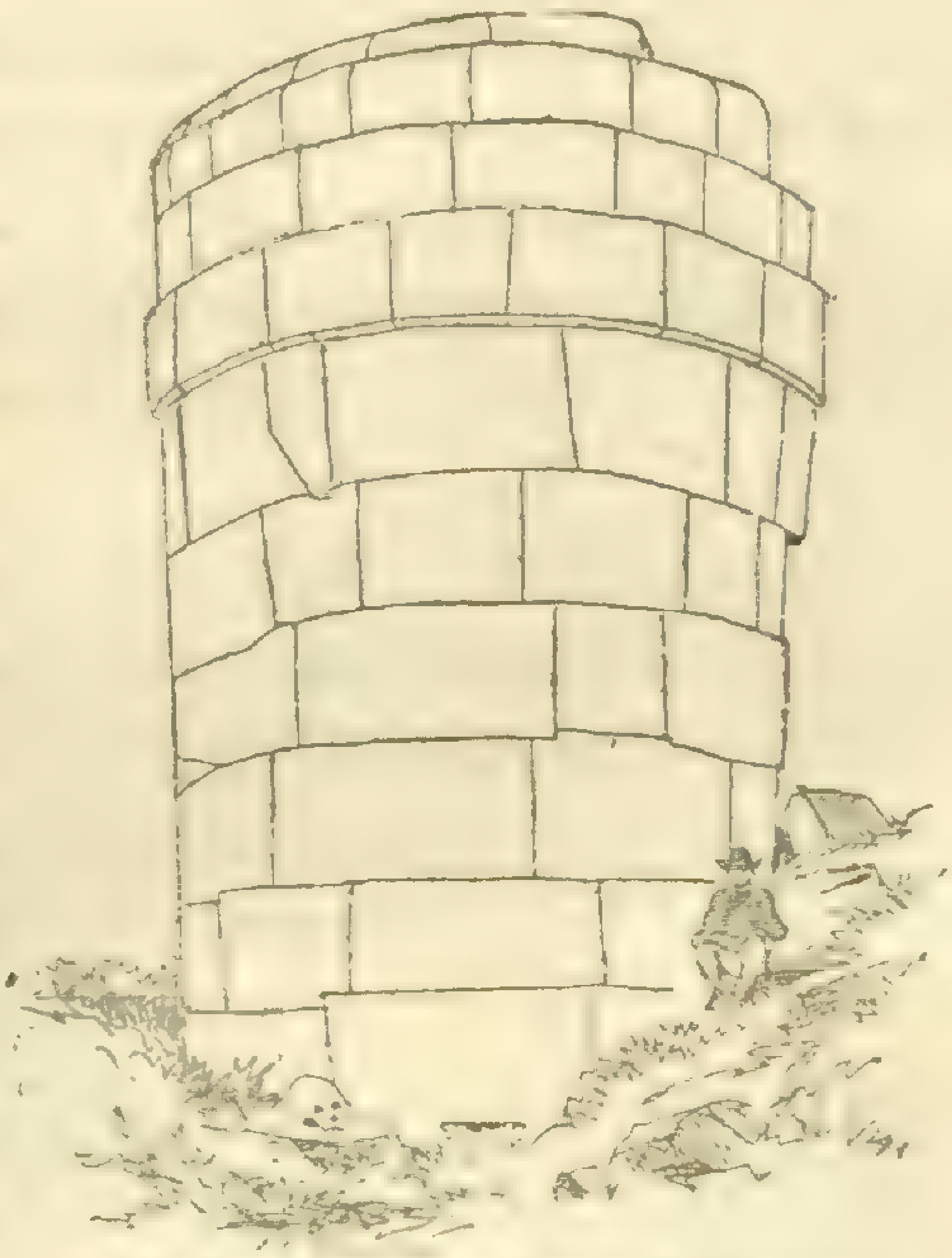
Now, in all these varieties of the burial monument called the *chulpa*, from the rude pile of rough stones at Acora, so much resembling the European *cromlech*, through every variety of form and phase of skill to the fine towers of Sillustani we discover common features, a common design, and many evidences that all were equally the work of the same people. If so, do the ruder monuments mark an earlier and possibly very remote period in the history of that people? And do the various stages of development which we observe in this class of monuments, correspond with like stages in the development of their builders? Or did they build the rough tomb

* For purposes of comparison, I introduce a reduction from a photograph, of a view of a so called Pelasgic round tower, among the ruins of Alatri, Italy (Fig. 7). The resemblance between the style and workmanship of the Sillustani monuments and those of Alatri is strong, except that the stones of the former are much the largest, and are cut and fitted with much greater accuracy. In no part of the world have I seen the art of stone-cutting and fitting carried to the point of perfection it was by the ancients of Peru.

for the poor and insignificant, and the grander and more elaborate monument for the rich and the powerful, as we do today?

I incline, for reasons not altogether drawn from an investigation of this single class of monuments, to the opinion that the various forms of the *chulpa* are indices of different eras. I doubt if monuments were ever raised, whether rude or imposing, except over important persons. I believe that anciently as now, the common Indian, the patient servant of the chief or *curaca* of old, as of the *gobernador* of our age, received few burial honors. His grave was unmarked by stone or symbol. The *chulpas* probably signalize the graves of individuals distinguished in their periods, upon which contemporaneous skill and effort were expended. If the monument was rude, it was because the people who raised it were also rude. At the time it was erected the *cromlech* or *chulpa* of Acora cost, it may be, an effort as great or greater than was exhausted, at a later period, on the elaborate and imposing towers of Sillustani. And, altogether, I am convinced, speaking for the present only in view of sepulchral monuments, that their development in Peru may be traced from their first and rudest form up to that which prevailed at the time of the Conquest, preserving throughout the same essential features.

Fig. 6.



Chulpa, or Burial Tower, Sillustani.

But it is not in the early sepulchral monuments of Peru, that we have absolute coincidences with the remains which are now accepted as among the primitive monuments of mankind. As we find in both Europe and Asia the rude

monuments of religion existing side by side with those of sepulture, so we find in Peru the Sun-circle, or primitive, open, symbolical temple, side by side with the Peruvian *chulpa*. In many places we discover circles defined by rude upright stones, and surrounding one or more larger upright stones placed sometimes in the centre of the circle, but oftener at one-third of the diameter of the circle apart, and on a line at right angles to another line that might be drawn through the centre of the gateway or entrance on the east.

In connection with the group of *chulpas* at Sillustani, or rather on the same promontory on which these occur, are found a number of such Sun-circles, which seem strangely to have escaped the notice of travellers. The tradition of their original purpose is preserved in the Quichua name they still bear of *Intihuatana*, "where the sun is tied up."*

Some of these circles are more elaborate than others, as shown in the engraving (Fig. 8), from which it will be seen that while the one nearest the spectator is constructed of simple upright stones, set in the ground; the second one is surrounded by a platform of stones more or less hewn and fitted together. The first circle is about ninety feet in diameter; the second about one hundred and fifty feet, and has a single erect stone standing in the relative position I have already indicated. A remarkable feature in the larger circle is a groove cut in the platform around it, deep enough to receive a ship's cable.

I am well aware that many of the smaller so called Sun-circles of the old world are rather grave-circles, or places of sepulture; but that in no way bears on the point I am at present illustrating, namely: the close resemblance if not absolute identity of the primitive monuments of the great Andean plateau, elevated thirteen thousand feet above the

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* *Inti*, in the Quichua language, signifies the Sun, and *huatana*, the place where or the thing with which anything is tied up. The compound word is still applied by the Indians to dials and church clocks. *Huata* signifies a year.

sea, and fenced in with high mountains and frigid deserts, with those of the other continent.*

Peru has many examples of that kind of stone structures called Cyclopean, in which stones of all shapes and sizes are fitted accurately together, without cement, so as to form a solid whole. The great Inca fortress of the Sacsahuaman, dominating the city of Cuzco, the old Inca capital, is one of the most imposing monuments of this kind in America or the world, and claims to rank with the pyramids themselves as an illustration of human power.

Fig. 7.

"Pelasgic" tower, Alatri, Italy. (See foot note p. 8.)

But apart from remains of this kind, which characterize comparatively late eras, we find remains of similar design, often imposing, but rude, and on the stones of which we look in vain for the traces of tools of any kind. In con-

*Cromlechs and Megalithic monuments appear to have been under discussion in the Ethnological Society of London during the past year (1869). Mr. Hodder M. Westropp, while indicating their wide range from Etruria to Malabar, from the steppes of Tartary, to the centre of Arabia, and from Scandinavia to the Pacific Islands, insisted on their purely sepulchral character, and regarded them, even when taking the form of great circles, simply as tombs, indicative of a very early and low phase of civilization. He seems to have supported his views (of which I have only an abstract in

struction they somewhat resemble the works uncritically known as *Pelasgic*. A notable example may be named in the ruins of Quellenata, already mentioned, situated on a mountain dominating the town of Vilcachico, and overlooking Lake Titicaca (Fig. 2). Still another, but less rude, is the great fortress of Chancayillo or Calaveras, in the upper part of the valley of Casma.

Tradition affirms that these *pucaras*, or strongholds, were reared long ago, when the inhabitants of Peru were divided up into savage and warlike tribes, "before the sun shone," or the Incas had established their benignant rule. They are held in a certain veneration as the works of giants, whose spirits still haunt them, and require to be propitiated with offerings of *chicha* and *coca*. Hundreds of these remains, often of great extent, crown the bare mountain tops of Central and Southern Peru and Bolivia, and are scattered all through the grand Andean plateau. Looking upon them in their obvious character, expressed also in their name of *pucaras*, as strongholds or fortresses, we find them to be but rude types of the extensive and elaborate defensive works constructed by the Incas, and in which were introduced parapets, salient and reëntering angles, and many of the

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French) by the circumstance that human bones, and other evidences of sepulture, are found in all or nearly all of these monuments. But we know that the temple and the tomb have gone together from time immemorial, lending to each other reciprocal sanctity and reverence. Will the antiquaries of the future quarrel over the question whether Westminster Abbey and the Church of St. Denis were tombs or temples, one or both? In this discussion Mr. Lane Fox (and I am still confined to the abstract alluded to), after indicating a still wider area for megalithic monuments than Mr. Westropp, including the Canary Islands, Algeria, Palestine, Persia, the Fejee Islands and the Ladrones, leans to the hypothesis that they were the work of one people that spread east and west, between barriers of seas like the Mediterranean on the south and eternal snows on the north, and that civilization was developed on the line of their occurrence. And that, the vast regions in which they are not found (in which America is enumerated), "are precisely those where civilization never penetrated." Civilization is, of course, a relative term, and one to which nations who in this age go to war with one another may doubtfully aspire, but to which the beneficent Incas, to say nothing of the Arcadian inhabitants of New Mexico might lay good claim. Still, if megalithic monuments of any kind are evidences of civilization, or even of its first stages, Peru, from what has been inserted in the text, can no longer "be left out in the cold;" and if civilization took the route of these monuments it certainly spread "laterally" past the Pacific Islands to America, or — *vice versa*.

most important features of modern fortifications. In short, as we find in the rude *chulpas* of Acora, the essential features of the imposing and skilfully constructed burial towers of Sillustani, so we find in these primitive defenses the fundamental ideas subsequently elaborated in the gigantic fortresses of Sacsahuaman, Pisac, and Ollantaytambo. Some instances fell under my notice in Peru, of single rough upright stones, occasionally of great size, which were *huaca* or sacred, and to which great reverence is still paid by the Indians. A notable instance is to be observed on the sum-

Fig. 8.

Intihuatanas of Sillustani, Peru.

mit of a high, bare hill, on the road between the port of Simanco and the town of Nepeña, and which overlooks the interesting ruins of Huaca-Tambo. No doubt some of these stones were set up by hand of man, but most of them occupy natural positions.*

The celebrated ruins of Tiahuanaco in Bolivia, which may be called the Stonehenge or Carnac of the new world, afford a striking example of the artificial arrangement of rough as well as upright stones, in the form of squares and rectangles,

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*The Indians of the coast of Peru raised large stones in their *chacras*, gardens and cultivated fields, which they called *chichoe* or *Truanca*, also *chacrayoe*, or Lord of the *chacra*. This stone received especial reverence at seed time.

and on parallel lines. Here we find quadrangles defined by huge, unhewn stones, worn and frayed by time, and having every evidence of highest antiquity, by the side of other squares of similar plan, but defined by massive stones cut with much elaboration, as if they were the work of later generations, better acquainted with the use of tools fit for cutting stones, who nevertheless retained the notions of their ancestors, bringing only greater skill to the construction of their monuments. The megalithic remains of Tiahuanaco rank second in interest to none in the world.

Fig. 9 is of a singular monument, in the ancient town of Chicuito, once the most important in the Collao. It is in the form of a rectangle, sixty-five feet on each side, and consists of a series of large, roughly worked blocks of stone, placed closely side by side on a platform, or rather on a foundation of stones, sunk in the ground, and projecting fourteen inches outward all around. The entrance is from the east, between two blocks of stones, higher than the rest. This may be taken as a type of an advanced class of megalithic monuments by no means uncommon in the highlands of Peru. The features I seek to illustrate would be made more apparent by a greater number of views, plans, and sections than I am now able to present, as may be inferred from the few accompanying this paper. When they shall come to be fully illustrated, I think all students will coincide with me in my already matured opinion that there exist in Peru and Bolivia, high up among the snowy Andes, the oldest forms of monuments, sepulchral and otherwise, known to mankind, exact counterparts in character of those of the "old world," having a common design, illustrating similar conceptions, and all of them the work of the same peoples found in occupation of the country at the time of the Conquest, and whose later monuments are mainly if not wholly the developed forms of those raised by their ancestors, and which seem to have been the spontaneous productions of the primitive man in all parts of the world, and not necessarily nor even probably derivative.

Fig. 9.

Ancient Monument, Chicuito.

I have only to add one word in respect to caverns. There are many of these in the *sierras* of Peru, in which the modern traveller is often glad to find refuge, as was the Indian voyager before him. But few of these however, seem to have been inhabited. Generally they appear to have been used as burial places, and abound in desiccated human bodies, human bones, objects of human art, and the bones of indigenous animals, often cemented together with calcareous deposits. Some of the many Peruvian traditions affirm that the ancient inhabitants of the country emerged from the limestone caverns in the frontier Amazonian valley of Paucartambo.* The best accepted perhaps of the Peruvian traditions assigns to the Sun-born Manco Capac, his birth-place and early residence in a shallow cavern on the island of Titicaca, out of which the sun rose to illuminate the earth, and which was regarded as the most sacred spot in the Inca Empire. That man should first seek shelter in caverns, in a cold and arid region like the *plateau* of Peru, where wood is scarce or unknown, is equally natural and probable; but the evidences of such a practice do not exist, or rather have not yet been discovered.

That considerable aboriginal Peruvian tribes once lived in houses built on piles, or on floats, in the shallow waters of the Andean lakes, is not only probable but certain. The remnants of such a tribe, bearing the name of Antis, still live in this manner in the reedy lakes formed by the spreading out or overflow of the Rio Desaguadero, the outlet of Lake Titicaca. These people spoke and still speak a lan-

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* The old Jesuit, Arriaga, in his rare and valuable work *Extirpacion de la Idolatria del Peru* (1621), tells us not only that the inhabitants of the coast of Peru reverenced the *Huaris*, "who were their ancestors and also giants, but the buildings erected by them." He adds: "They reverence also their *Pacarinas*, or places of ancient residence, to the degree of preferring to live in them, notwithstanding that they are built in lofty, rocky, arid places, often a league from water, and only possibly to be reached, and even then with difficulty, on foot."

The word *Pacarina*, as given by Arriaga, is embodied in that of Paucartambo, the name of one of the upper Amazonian Valleys, running parallel to that of Yucay, near Cuzco, whence, one of the traditions of the Incas derives the founders of their civilization and empire. The name is only a corruption of *Pacari*, to be born; and *tampu*, a dwelling or stopping place—the whole being equivalent to birth-place or homestead.

guage differing equally from the Aymara and Quichua, called Puquina, and the early chroniclers speak of them as extremely savage, so much so that when asked who they were, they answered, they were not men but *Uros*, as if they did not belong to the human family. Whole towns of them, it is said, lived on floats of *totora* or reeds, which they moved from place to place according to their convenience or necessities.

REMARKS ON SOME CURIOUS SPONGES.

BY PROFESSOR JOSEPH LEIDY.

AMONG the many remarkable marine productions which puzzle the naturalist as to their relationship in the animal kingdom, is the *Hyalonema mirabilis* of the Japan seas. First described and named by Dr. John E. Gray, of the British Museum, this distinguished zoologist viewed it as a coral related with Gorgonia, or the Sea Fan.

The specimens of Hyalonema, as ordinarily preserved, appear as a loosely twisted bundle of threads converging to a point at one extremity of the fascicle and more or less divergent at the other. The threads bear so much resemblance to spun glass that the production has received the name of the Glass Plant. They are mainly composed of silex and are translucent, shining, and highly flexible. The fascicle is upwards of a foot and a half in length and near half an inch thick. The threads range from the thickness of an ordinary bristle to that of a stout darning needle.

Specimens of the Hyalonema fascicle, as they have been brought to us, almost invariably present some portion invested with a brown warty crust; the wart-like elevations terminating in a cylindrical ring with radiating ridges. These elevations are the individual polyps, continuous through the

intervening crust, of which Dr. Gray views the fascicle as the central axis.

In some specimens of the Hyalonema fascicle the narrow end is enveloped in a spongy mass, or as Dr. Gray observes, "a species of sponge." He supposes the sponge to be independent of the fascicle or "coral," though necessary to it as a means of attachment in its habitation. According to this view the fascicle with its warty crust, is a parasite of the sponge into which the fascicle is inserted. Dr. Gray remarks that "in general the specimens are withdrawn from the spongy base and the lower part of the axis is cleaned; but it is evident that they all are attached to such a sponge in their natural state."

When the writer first had an opportunity of seeing a specimen of Hyalonema, consisting of a fascicle partially invested with a warty crust, presented to the Academy of Natural Sciences of Philadelphia in 1860, and before he had seen an account of the remarkable production, his impression was that it was a silicious fascicle of a sponge, upon which a parasitic polyp had found a convenient and secure resting-place. M. Valenciennes had previously expressed a similar opinion, as observed in the introduction to Professor Milne Edwards' work on British Fossil Corals.

Notwithstanding the frequency of silicious threads entering into the composition of many sponges, Dr. Gray remarks, in referring the Hyalonema fascicle to a coral, that this is peculiar "as being the only body the animal nature of which is undoubted that is yet known to secrete silica; the spicules and axis of all the corals which had fallen under his observation being purely calcareous."

Professor Brandt of St. Petersburg views the fascicle and its warty crust as parts of a polyp, and the sponge mass as a parasite which attaches itself to the polyp, gradually penetrating its silicious axis, and finally killing it.

Dr. Bowerbank who has so extensively investigated the sponges in general, regards all three of the elements of the

Hyalonema—the fascicle, the warty investment and the sponge mass—as parts of one sponge. The wart-like elevations of the crust he views as oscules of the sponge.

Professor Max Schultze of Bonn, has published an elaborate memoir on the Hyalonema, accompanied by beautiful plates of perfect specimens preserved in the Museum at Leyden. He represents the fascicle and the sponge mass attached to one end as belonging together, while the warty crust is referred to a polyp, to which the author has given the name of *Polythoa fatua*.

To conclude these discordant views, we may add that of the distinguished micrologist Ehrenberg, who considers the fascicle as an "artificial product of Japanese industry."

The Hyalonema in Professor Schultze's work, is represented as a sponge mass of conical or cylindrical form with rounded summit, from which the rope of silicious threads projects. The sponge mass measures five inches long and three in diameter; the fascicle projects a foot and two inches. The sponge mass is described as composed of loosely interwoven cords of fine silicious needles. The entire surface, except the end opposite to the fascicle, is provided with numerous orifices about one line in diameter. The flattened end of this sponge mass is furnished with six orifices half an inch in diameter, communicating by canals in the interior with a system of interspaces finally ending in the smaller orifices of the surface generally.

The long silicious threads of the fascicle are composed of delicate concentric layers enclosing a fine central canal. The external layer appears to be composed of imbricating rings, most conspicuous toward the free end of the thread and almost or quite disappearing toward the other end. The arrangement reminds one of the appearance of the cuticle on the hairs of mammals. The projecting edges of the ring toward the free ends of the thread are most prominent and also form reversed hooklets.

Professor Schultze regards the sponge mass as situated at

the bottom of the fascicle, and its flattened extremity with the large oscules at the base. This appears to be the general view, but it has occurred to me that the sponge mass in its natural position was uppermost, and was moored by its glassy cable, or rope of sand, to the sea bottom, perhaps to marine algæ. This opinion is founded on the circumstance that in sponges generally the large oscules from which flow the currents of effete water are uppermost. The ends of the threads of the fascicle, with their reversed hooklets, are also well adapted to adhere to objects.

The equally wonderful and still more beautiful *Euplectella* of the Philippines was also at first represented upside down, as seen in the figure of Professor Owen in the "Zoological Transactions of London," the reverse of the position now assigned to it as represented in figure 76 of the third volume of the NATURALIST. In the same manner Euplectella and Hyalonema appear to me to be alike constructed so as to be anchored in position by the silicious threads, with their reversed hooklets. It may be that Hyalonema, in its home, is suspended by means of its glossy cable, but I think it highly improbable that it should either sit or be attached by the base of the sponge mass in which the large oscules are placed.

In the Proceedings of the Zoological Society of London for 1867, Dr. Gray observes that, according to Dr. William Lockart, "the Japanese Hyalonema is found growing on the rocks of the island of Enosima not far from Yokohama. The fishermen offer the sponges with their silicious fibres for sale to visitors at the temples of Enosima."

An entirely different sponge, apparently intermediate in character with Hyalonema and Euplectella, recently described in the Proceedings of the Academy of Natural Sciences of Philadelphia, under the name of *Pheronema*, would appear to throw some light upon the question of what belongs to Hyalonema. The specimen, obtained from the island of Santa Cruz, W. I., is preserved in the Museum of

the Academy. It is represented in the accompanying figure (Fig. 10), one-half the natural size. The body of the sponge is oblong ovoidal, with one side more protuberant than the other. The narrower extremity, which I suppose to be the upper, is conical, and its truncated apex presents a single, circular orifice, the third of an inch in diameter. The opposite extremity is rather cylindrical with a broad, slightly rounded extremity, from which project numerous fascicles of silicious threads.

Fig. 10.

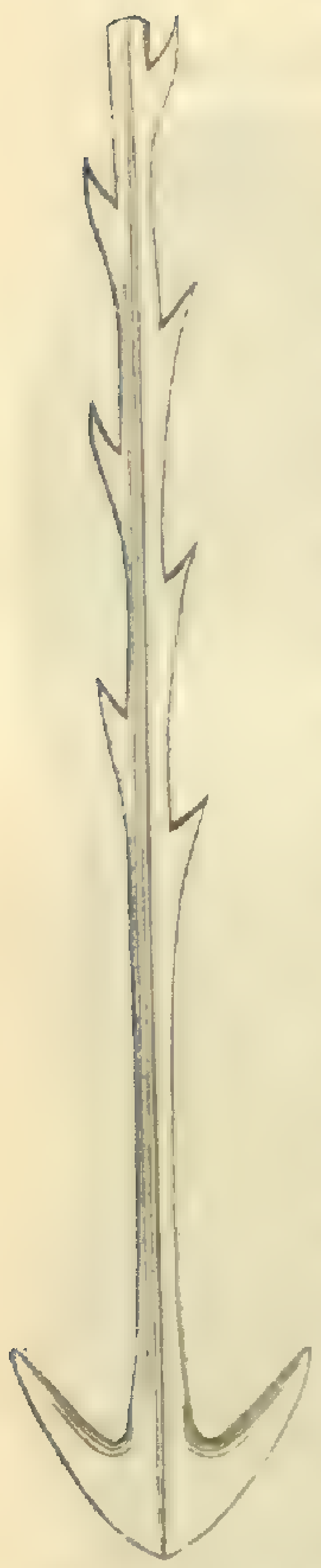
The sponge body is of a light brown hue, and rigid to the feel. Its surface exhibits an intricate interlacement of the sponge tissue, which appears mainly composed of stellate, silicious spicules of various sizes. The coarser spicules of the surface, of which one is represented in Fig. 11, three times the diameter of nature, have five rays. Four of these together are irregularly cruciform, while the fifth projects in a direction opposed to all the others. They appear to be so arranged that the crucial rays interlace with those of the contiguous spicules, forming a lattice work on the surface of the sponge, while the odd ray opposed to the others penetrates the interior of the sponge. The finer tissue, seen through the intervals of the latticed arrangement on the surface of the sponge, appears to be made up in the same manner of finer stellate spicules. Some of the largest stellate spicules of the surface have a spread of half an inch.

Fig. 11.

The fascicles of silicious threads projecting from the body

of the sponge are upwards of twenty in number and over two inches in length. They resemble in appearance tufts of blonde human hair. The individual threads are nearly like those proceeding from the lower end of Euplectella. Where thickest they are less than the $\frac{1}{200}$ of an inch in diameter, and become attenuated towards the extremities. At first, as they proceed from the body of the sponge, they are smooth and then finely tuberculate. The tubercles are gradually replaced by minute recurved hooks, which become better developed approaching the free end of the threads which finally terminate in a pair of longer opposed hooks, reminding one of the arms of an anchor, as seen in Fig. 12. The object of the tufts of threads, with their lateral hooklets and terminal anchors, would appear to be to maintain or moor the sponge in position in its ocean home.

Fig. 12.



The singular sponge thus described, the author has attributed to a genus distinct from Hyalonema and Euplectella, and has dedicated the species in honor of his wife, under the name of *Pheronema Annæ.*

Of the specimens of Hyalonema in the Museum of the Academy of Natural Sciences of Philadelphia, there is one which appears to the writer as somewhat significant. The fascicle would appear to have been withdrawn from its sponge body and lain sometime in the sea before it was found. This is inferred from the fact that the Polythoa crust reaches to within an inch and a half of the end, which in the natural condition is inserted in the sponge mass. Two sharks eggs are also attached to the fascicle by their tendrilled extremities, and one of the tendrils clasping the fascicle is included in the polyp crust.

THE FRESH-WATER AQUARIUM.

BY CHARLES B. BRIGHAM.

[Concluded from page 490, of Vol. iii.]

A VERY valuable addition to the specimens of an aquarium may be found in what are called the cray-fishes or fresh-water lobsters. These little animals so closely resembling their salt-water relations can be kept without much trouble in the general collection. They are natives of most parts of the country, though rare or limited in their habitat in New England. In New York they are abundant in the gravelly brooks and streams, especially in those near Trenton Falls. A careful observer will, as wading into the water he searches for them, see two claws just visible in a hole in the sand or under the edge of a rock; and if he can hedge the hiding place around with his net, and also possibly his straw hat, and then give the desired specimen a slight stimulus with his hand, he will find of a sudden his cray-fish resting quietly in the trap he has set. So quick are their motions that one has to keep a sharp lookout for them or they will escape; the average length of those found near Trenton Falls is about two inches. They are quite hardy, with this exception that they cannot bear water which is much above the normal temperature. In the summer time if the tank is so placed that the sun shines upon it too forcibly, or for too long a time, we shall probably find the cray-fish resting motionless upon the gravel with its claws and tail extended and its body somewhat swollen. If this state of things has not existed too long a time, immediate removal to cold water may revive the unfortunate victim by degrees. Some day, after the cray-fish has been a quiet inmate of the aquarium for some time, we shall be astonished in finding apparently two cray-fishes instead of one. Closer examination will disclose the fact that one of them is merely the cast-off shell of the

other; and now the newly clad cray-fish appears in a coat of a pinker hue than before, and tries to keep under the plants and conceal itself, until accustomed to its new garment it can venture forth once more into its little world. Cray-fishes eat small pieces of raw beef eagerly. We shall have to be careful that they do not crawl out of the tank, for if even a tassel of a curtain is left so near the water that it can be reached, we shall find our much prized specimen some morning dried up and lifeless in a corner of the room upon the floor.

Frogs are interesting objects of study, and to many are great favorites; they are best kept in a tank with an inch or two of water, with a number of islands or resting-places above the water for them. A wire screen over the top of the tank will be necessary to keep the specimens together.

Two of the most useful and instructive sets of specimens which the aquarium contains are its snails and mussels; useful, because they act as the scavengers of the tank, and from what would otherwise be the refuse matter make their living from day to day; instructive, because they serve to illustrate in a small way the great principle by which the health and purity of all our larger ponds and lakes is maintained. The snails live upon the bits of decayed plants and the confervoid growths in the tank, and the mussels by filtering the water act as constant purifiers. There are three kinds of snails common in our ponds and streams, the *Planorbis trivolvis* the *Paludina decisa*, and the *Lymnæa desidiosa*. Of these the best is the Planorbis, a snail with a shell coiled like a modern chignon; it is hardy and of clean habits, and does almost as much work as its neighbor, the Paludina; it is found chiefly in ponds or large streams, while the Paludina can be obtained in great numbers in small brooks or pond holes. The Lymnæa is found near the gravelly beaches of the larger ponds; it is a beautiful snail, but does not confine itself to the refuse matter, and is apt to eat eagerly the most delicate plants in the tank; it is, therefore, generally an

unwelcome visitor. Of the mussels, those found in ponds with their many rayed shells, and those river mussels with their thick, unattractive coverings, are alike useful; they move from one side of the tank to the other with ease, and we must not expect to find them always in one position; the number of snails which may be kept to advantage in a tank is very large; they are so apt to perish during the winter that it will be well to begin the season with as large a stock as two hundred for a medium sized tank; a dozen mussels of a size proportioned to the tank will be sufficient.

There are many specimens, such as fishes at the time of spawning, or those particularly fierce, or certain larvæ, which would either be destroyed or seen to disadvantage in the general collection. For each of these a separate tank is indispensable; some glass jars of strong clear material holding about two quarts, will answer every purpose, and the contents can be arranged precisely as if they were large aquaria. After one has had an aquarium in operation for some time extra tanks of this sort will be found very useful and necessary; for if a specimen gets injured or is in poor condition, a few weeks recruiting in a separate tank will often save its life; or, if we have a larger stock of plants than the large tank will accommodate at the time, when later in the winter the plants die off, then we shall wish to replace them from specimens in the reserve stock.

The instruments used for aquarial purposes are few in number and simple. We need a good net a foot or two in diameter, with very fine meshes, and a flat basket so partitioned off that it will hold four good sized jars; these jars may be of earthen-ware or of strong glass, the latter material being perhaps better, as we can then see how many specimens each jar contains without trouble. Most of the plants can be taken home (if the distance is not too great) rolled up in the net, while the mussels can occupy the room between the jars. It is very necessary to keep the plants moist, as they are much blighted if allowed to dry; if

covers for the jars are used at all they should be caps of mosquito netting held on by India-rubber rings.

For the tank a glass rod about a foot in length and a quarter of an inch in thickness will be of use in moving the specimens into place when disarranged. Too much cannot be said against unnecessarily meddling with the specimens in the aquarium; a slender rod with a sponge attached to the end of it will be useful in removing the confervæ from the sides of the tank; a small gauze-net three or four inches in diameter is often needed to remove dead or objectionable specimens; an India-rubber pipe several feet in length affords the simplest method of drawing off the water of the tank; a fine gauze should be placed over that end of the pipe which is in the tank, otherwise the specimens may pass through it and be lost.

Should the water in the tank become impure by any means it can often be purified by the following simple method: take a small earthen flower-pot holding about a pint, and insert a piece of sponge tightly in the opening at the base so that when the water is placed in it it will pass through the sponge only drop by drop; the pot being filled with one-third powdered charcoal and two-thirds water, place it over the tank and let it empty itself into the aquarium. The effect of this simple contrivance is astonishing and it will often save one the trouble of arranging the aquarium anew.

The time of feeding and the amount of food may depend somewhat upon the kind of stock in the aquarium. As a general rule it is better to keep the specimens under than over-fed, for they do not then by wasting their food make the water impure. Twice a week is often enough to feed them, and then very small pieces of raw beef will be found the best food; gold-fishes will not always eat the beef, and for them crumbs of bread are necessary; should we find that they do not eat all that is given we must stop the feeding at once and remove with the glass rod the neglected portion.

The process of accustoming certain salt-water fishes, such

as minnows and stickle-backs, to fresh water must be done gradually if we wish a happy result; in this process we have an example to follow, set by nature herself, for there are instances of bodies of what were once salt waters, so freshening by degrees that they still retain seals and certain marine animals. We may find crabs in the Charles River at some distance above Cambridge, and they may be kept alive and in health for a length of time in the fresh-water aquarium.

The system of artificial aëration and that of producing an ebb and flow in the marine aquarium have been practiced with success in large collections of aquaria.

The value of the aquarium as a means of instruction cannot be overestimated, affording as it does the opportunity of studying the habits of aquatic animals in a manner attainable by no other means, and giving to all an inducement to pursue further the study of natural history which will be a pleasure throughout life.

A SKETCH OF THE TRUCKEE AND HUMBOLDT VALLEYS.

BY W. W. BAILEY.

Since the opening of the Pacific Railroad all have had their attention more or less turned to that vast region lying between the Sierra Nevada and the Rocky Mountains. It is known as the Great Basin; but if, misled by the name, we conceive merely of a boundless valley, more or less desolate, we shall arrive at a somewhat erroneous conclusion. It is indeed a depression between the two giant ranges of the continent, but traversing this are successive parallel mountain chains with a north and south trend, and only inferior in altitude to the Rocky Mountains and the Sierra. Indeed, according to our eastern notions, the whole so-called basin is but a broad

mountain top, as no portion of it is below four thousand feet. Notwithstanding the general sterility of the soil it will be seen, as I proceed, that it sustains quite an extensive and peculiar flora. With the belief that a brief sketch of this unique region will be of interest to naturalists I have ventured to present the results of my observations.

My first botanical rambles were along the banks of the Truckee River, which has its source in Lake Tahoe, a lovely sheet of pure, cold and clear water, situated on the eastern boundary of California. From this Alpine lake the little river flows into the Great Basin and waters some of the best farming lands in Nevada. It is a narrow and rapid stream, mostly shallow, and with a rocky or sandy bottom. At intervals nature has adorned its banks with groves of cottonwood (*Populus monilifera*). It is sincerely to be hoped that these noble trees will be spared by the rapacious wood-choppers, as in a country so meagre in its sylva, a green thing, if it be but a shrub, is cheering to the spirit, and a full-sized tree is a positive delight. The size of these poplars, and the wide spread of their branches, render them especially welcome to the traveller, who, parched and weary, seeks refuge within their shade.

In speaking of the plants of Nevada it is convenient to classify them much as they are distributed in nature, and we find that according to their location they naturally fall into three grand divisions:

1st. The plants of the river bottoms and margins of irrigating canals.

2d. Those found on the desert plains at a distance from water.

3d. Those of the mountains.

These main divisions for ease in study may again be subdivided into sections almost as naturally marked, namely:

A marginal section immediately contiguous to the rivers or lakes.

A meadow tract, moistened generally by artificial irriga-

tion or by streams descending from the mountains, and usually dry in the summer months.

A desert section proper and one more particularly pertaining to the alkaline flats and vicinity of saline springs.

Lastly, the flora of the mountains is naturally divided into two distinct fields, according as the plants grow in the cañons in the vicinity of water, or flourish on the higher and more exposed regions where in the summer months little or no moisture is obtained, unless from an accidental shower, or by direct condensation from the atmosphere. Of course these divisions are more or less arbitrary and shade the one into the other. Following the above order we observe that on the Truckee there are a few plants immediately bordering the river and small streams which have apparently been drifted from above with soil and debris swept off by floods. The original habitat of some of these plants, I presume to be the neighborhood of Lake Tahoe, although no definite data can be given in support of such an opinion without an examination of the flora near the source of the stream. Still, certain plants which I always found on sandy shoals and islands in the Truckee, and nowhere else, lead me to this conclusion. Seeds, too, have undoubtedly been transferred from place to place through the same medium; but whether, with the exceptions just mentioned, the prevalent plants have advanced from the east or the west, I am not prepared to say. It would require for the study more time and larger experience than it was my lot to bestow upon it. The species of plants found along the Truckee at one camp differed but slightly from those discovered at another, preserving a close resemblance to each other as far as Wadsworth, the limit of my investigations. It would be tedious and uninteresting to read a list of the plants found in this region, a more correct account of which will, I hope, soon be given to the public by one more competent to treat of them, and I shall therefore only mention such as are conspicuous to the traveller as he passes by, or such as have a positive or

possible industrial value. Among the smaller plants a species of mint is common, and a hemp from which the Pi-Ute Indians make their bow strings. There is also a highly ornamental species of sunflower (*Helianthus*), well worthy of cultivation, as its smaller and more brilliant flowers render it more attractive than the grosser garden form. The Mexican Poppy (*Argemone Mexicana*), is occasionally seen, and a thistle, which I consider unequalled in beauty. The delicately cut leaves look as if formed of silver, and the flower resembles a paint-brush charged with scarlet lake. I have before mentioned the fine groves of cottonwoods, but in addition to these a fringe of willows is often found along the stream, and a mingled thicket of "Buffalo berry" (*Shepherdia argentea*), Roses (*Rosa blanda*), and other shrubbery. The bright berries of the Shepherdia and scarlet lips of the rose present a pleasing appearance, contrasted, as they are, with the silvery leaves of the former plant. When the roses are in bloom the effect must be even more charming.

Near Hunter's Station the river flows through extensive meadows producing abundance of hay and vegetables. The native grasses are mostly grown, but our own well-known "Timothy" (*Phleum pratense*), has been introduced to some extent, and is always much prized. This valley and that of the Carson form decidedly the richest portion of the state. The meadows are bounded by Washoe Peak, an outlying spur of the Sierra, by the Pea-vine mountains (so-called from the frequency with which the lupines or wild peas are met with on its sides), and a range lying to the east on which is situated Virginia City. That town, however, is not visible from the river. Washoe Peak is of very great height, and frequently shows snow upon its summit even in midsummer. It is a splendid mountain in form and color, and is especially admirable when the clouds which droop over its snowy sides, are suffused with California's own golden tints. After leaving this fertile valley, the Truckee enters a narrow gorge between high rocky hills, often beautiful in the colors

of their exposed strata and always in the graceful outline of their summits. Upon the higher portions only of these hills grows the juniper (*Juniperus occidentalis*), the chief and best firewood of this region, where fuel is so scarce that during the winter of my sojourn, wood sold as high as thirty dollars in gold in Virginia City. The cottonwoods are also sometimes used for fuel by those residing near the river, together with drift wood brought down from the Sierra. The lower slopes inclining to the stream support only the scraggy sage brush (*Artemisia*). Yet even in this narrow defile the farming lands are excellent, and are occupied and cultivated by thrifty settlers. The Truckee after flowing in a general easterly direction as far as Wadsworth, suddenly bends and following a north-west course empties into Pyramid Lake. This is a sheet of water about thirty-five miles in length and ten or twelve in width at the widest part. There are many small and steep rocky islands in the lake, some of them covered with an arborescent tufa resembling coral in its appearance. One very abrupt, pyramidal island gives its name to the lake which was discovered and partially explored by Fremont. The islands are the temporary home of pelicans and other sea fowl, who frequent them in the breeding season, and share the rocky soil with numerous rattlesnakes and lizards. Near the mouth of the river the land is good though subject to overflows, which while they fertilize the soil for future growth, often jeopardize the present crops. This land is held as a reservation by the Pi-Ute Indians, but even this remnant of their once broad acres is coveted by the neighboring whites. The lake is surrounded by mountains, and the lands removed from the water are of little or no value unless artificially irrigated.

Just before its *embouchure* the Truckee throws off a branch which supplies Winnemucka Lake, parallel to Pyramid, but separated from it by a narrow strip of highlands and mountain ridges. This lake is rarely found on any but the most recent maps and we are led to wonder how it could

have been overlooked. The fact that it is increasing in depth while Pyramid is said to be decreasing, seems to indicate that it is of recent origin and occasioned by some accidental deflection of the Truckee from its legitimate course. The fresh water of the river is soon deteriorated by admixture with that of the lake, which like all similar sheets, devoid of outlets, is brackish and unpleasant to the taste. The most showy plants of the Truckee Valley, in addition to those already mentioned, were a gigantic Thelypodium often rising to a height of six feet, two species of Mentzelia (*lævicaulis* and *albicaulis*) a species of Hosackia, and two of Cleome, and Sida. Near the mouth of the river occurs a remarkable deposit of infusorial earth. It is found encased in the calcareous tufa so prevalent in this vicinity. Under this lies the basaltic rock. The "chalk," as it is here called, is one hundred feet in width and forms a perpendicular bluff nearly forty feet in height from the stream, which at this point is very deep. The whole deposit is very free from impurities and upon microscopical examination, by my brother, proved to be composed entirely of fresh-water forms.

From the Truckee to the Humboldt Valley there is about a day's hard riding through deep sands and deserts devoid of water, where only grows a depauperate form of sage brush (*Artemisia*), or the equally dreary grease wood (*Obione*). The hills in sight are of volcanic origin, and are covered with loose and blackened scoriaceous rocks, occasionally encased in tufa. There is not a vestige of a tree, shrub or herb, with the exception of the ashy colored sage or the singular Effedra (*anti-syphilitica*). The first and only object that awakens any interest is the group of hot springs. There are some fifteen or twenty of these presenting different degrees of temperature. One spring indicated 201° Fah., while others were positively cool. The water is beautifully clear, but contains salts in solution which render it unpalatable. It is, when cooled, however, preferable to most of the villainous decoctions of the sixty-three elements,

which, in the absence of the genuine article, pass in this region for water. It is often in a state of violent ebullition, and is thrown up in intermittent jets, especially when extraneous substances are introduced. Some of the springs of this region, highly saturated with mineral ingredients, build for themselves a conical chimney, as it were, by the deposition of their dissolved constituents. Coarse and wiry, but verdant grasses spring up around. Sometimes living fish make their abode in these boiling springs, though not found in the particular group in question. I have seen them from similar wells where the surface of the water marked 70°. This statement is consistent with that of other observers in various parts of the world. Carpenter says "we have examples of the compatibility of even the heat of boiling water with the preservation of animal life. Thus in a hot spring at Manilla, which raises the thermometer to 187°, and in another in Barbary, whose usual temperature is 172°, fishes have been seen to flourish. Fishes have been thrown up in very hot water from the crater of a volcano, which from their lively condition, was apparently their natural residence." Various confervæ and animalculæ are known to occur in similar situations, and indeed, were noticed in these identical springs. Carpenter adds, "small caterpillars have been found in hot springs of the temperature of 205°, and small black beetles, which died when placed in cold water, in the hot sulphur baths of Albano." After these quotations I hope no one will charge me with Munchausenism. In apparent extravagance they certainly far surpass my statement.

A few hours after leaving the springs the road begins to descend, and soon a view is obtained of the basin into which both the Humboldt and Carson Rivers enter and "sink," or disappear in the sands. A broad, barren valley is stretched out before us, through which the course of the river is indicated by the fringe of green tules which border it. Occasionally the plain is marked by a tract of white alkaline

salts, looking like a snow field as it glistens in the sunlight. The mountains, most fantastic in outline, which border the valley, are enveloped in a gauze-like mist which seems to preclude all further inquiry into the features of the anomalous landscape. There is no live color in the scene. Even the greens with which nature usually relieves her more rugged details, are here wanting, except in the case of the tules above mentioned. Still there is a strangely fascinating and weird beauty in the view peculiar to these deserts. Here the Humboldt which begun its course far away as a fair young stream, expands into a lake, and becoming disgusted with its vitiated life commits suicide by self-burial. Hence the spot is known as the Sink of the Humboldt. At the sink proper, the water is intensely alkaline and disgusting to the taste, and the atmosphere is filled with noxious vapors and miasms. The legions of mosquitoes which infest the tules are the food of numerous water-fowl, to whom I candidly wish all success in their warfare upon the insects. Among the birds a black swan is said to appear at times, but I did not have the fortune to see one if any such occur. Above the lake the Humboldt is a narrow, sluggish and serpentine stream, hardly wider than an eastern creek and totally lacking its vivacity. The water is turbid and unpleasant to the taste. The fish which frequent it are when cooked soft and tasteless. Not a tree adorns the last hundred miles of the stream, low willows and Shepherdia being the nearest approach to arborescent growth. The lofty range of West Humboldt mountains are now in sight, whose highest point, Star Peak, rises to an altitude of nine thousand nine hundred and sixty feet above the sea. From the great height of the range, its direction north and south in conformity with the trend of the other ridges, its frequent water courses giving life and beauty to narrow belts of luxuriant vegetation, and the wide prospect to be obtained from its many commanding points, it affords numerous subjects for consideration. Many deep cañons channel its rugged

sides, most of which contain clear water. A strange fact in regard to these streams, is that they run freely, even boisterously, during the night and early morning, and dry up utterly in the lower part of their course toward noon. The power of the sun is such as to totally evaporate the water before it reaches the plains, while the powerful radiation during the night allows the stream to resume its proper dimensions. If a handkerchief be saturated with water at noonday and then flirted in the air, it becomes dry in a moment, thus indicating the wonderful absorptive power of the atmosphere. Rains are so infrequent in summer that it becomes a cause of wonders, not that the rills should fail, but that they should ever flow. Along these little streams willows, aspens (*Populus tremuloides*), Cornus, Shepherdia and elders (*Sambucus*) grow most abundantly, and Clematis with its feathery plumes waves over all. The herbage is peculiarly interesting also, columbines (*Aquilegia formosa*), asters and solidagos, leading us away in spirit to where their beauteous kindred smile upon the New England autumn, while the gilia (*G. pulchella*) and lupines are equally lovely though less familiar. Away from the streams the wild sage only thrives, if so wretched a specimen of vegetable life can be said to flourish. By far the greater mass of the mountains is desert, like the plains they overlook. The great, brown earth waves roll down into the valleys unrelieved by a dash of green, except where some sombre juniper fights its hard battle for life. Variously colored lichens occur on all the rocks, and an occasional tuft of moss on those exposed to the streams, but ferns are nowhere seen. High up on the range is found a luxuriant growth of a species of Ceanothus, and at seven thousand feet or thereabouts, the sage yields to the western juniper (*Juniperus occidentalis*) and mountain mahogany (*Cercocarpus ledifolius*). The latter is a handsome tree, averaging twenty feet in height, with bright glossy leaves, whose revolute margins conceal the brown scurf of their inferior surfaces. Its silvery bark, the

strangely plumose fruit and shining leaves render it very conspicuous. As in the case of the manzanita (*Arctostaphylla glauca*) of California, the wood is susceptible of a high polish and is used for many ornamental purposes. This tree and the juniper form the only respectable fuel which the country affords, and the traveller may consider himself especially blessed if he lights upon either when frantically searching for the wherewithal to kindle a blaze. The juniper is the more common tree, and is sometimes twenty or more feet in height. The wood is lighter colored and appears scarcely so compact as our eastern red cedar, which in other respects it closely resembles.

The character of the vegetation is quite different on opposite sides of the same range, many plants being found on one side which are not at all represented on the other. As a rule the eastern exposure is the more fertile. Instances of this peculiar distribution are the little alpine potentilla (*Ivesia Newberryi*) found in chinks and crevices of high exposed granite bluffs on the western side, and a curious moss-like Spiraea (*tomentosa*) only found in somewhat similar locations on the eastern side. A few eastern weeds thrive about the houses in Unionville, and I also found *Ranunculus cymbalaria* at quite an altitude in the cañons. This fact does not speak well for the soil, as this little plant generally favors the sea-shore or neighborhood of saline springs. A wild tobacco (*Nicotiana*) is common, which the Indians called "pah! monh!" pronounced as two interjections, and with much the sound of a person vigorously smoking an obdurate pipe. They informed us that it was formerly much used by their tribe, until superseded by the superior article of the white men. The fleshy roots of a Phelipaea they told me they employed as food in the month of October.

The view from the West Humboldt Mountains is very extensive and remarkable. The atmosphere is so pure in this region that it is possible to see a distance of sixty miles as readily as one could twenty at home. From this great

height range beyond range is seen both east and west, and there seems to be no limit to our vision. No positive colors enliven the landscape, giving it the pleasing variety of our eastern scenery, but there are only varying tints of brown in the foreground and light azure in the distance. The remote hills look as if merely outlined in blue. The valleys are dreary wastes, through which the roads may be seen winding. From these clouds of dust often rise a thousand feet into the still air. The dreary monotony of the desert is relieved at this distance by the broad plains of snow-white alkali, which it is well to view afar off. They have no fascination for the unfortunate traveller who inhales their smarting dust, penetrating as it does the eyes, nose and ears, and imparting a nauseous soapy taste to the mouth. These deposits often contain embedded crystals of rock-salt of great beauty.

About sunset is the proper time to really enjoy the weird prospect, for the colors the mountains then assume are most charming. The main masses look as if dusted with gold, while each cañon and ravine is filled with purple shadows. The delicate tints change rapidly, deepening and blending until finally night drops its curtain on the scene. Still the act is not closed, for the stars twinkle above the serrated outline of the mysterious mountains, or the moonlight transfigures their barren slopes.

When we study each detail of this anomalous scenery in its horrible individuality it seems unreasonable that the whole should in any way delight us, yet that it is fascinating is most certain. There is a peculiar coloring, or rather tinting, seen nowhere else, and never to be forgotten. I do not mean to say that the land is anything but a desert—a literal "howling" wilderness, nor do I maintain with many of the settlers that earth has no fairer habitations. It is an insult to a forest to call it a wilderness in the above sense, teeming as it is with myriad forms of life and beauty, but here where nothing interrupts the view but bare, treeless

mountains, is solitude complete and unbroken. Whatever be the charm, it is yet certain that having gazed once we admire the strange picture ever after.

REVIEWS.

REPORT UPON DEEP SEA DREDGINGS IN THE GULF STREAM.* — This number of the Bulletin sums up the results of the different expeditions, and is also especially valuable for many novel and interesting observations upon geological and zoölogical questions. According to Professor Agassiz, the fauna of the reef, consisting mainly of corals, extends to ten fathoms only. The second zone, "a muddy mass of dead and broken shells, broken corals, and coarse coral sand, is chiefly inhabited by worms, and such shells as by their nature seek soil of this character, with a few small species of living corals, some *Halcyonarians*, and a good many *Algæ*." This extends seaward "from a few miles" off Cape Florida to "twenty miles and more off Cape Sable." "A third region, or zone, beginning at a depth of about fifty or sixty fathoms, and extending to a depth of from two hundred to two hundred and fifty fathoms, constitutes a broad slanting table land, beyond which the sea bottom sinks abruptly into deeper waters. The floor of this zone is rocky; it is, in fact, a limestone conglomerate, a kind of lumachelle, composed entirely of the remains of organized beings, animals now living upon its surface." Algæ are but sparsely represented upon the plateau, and though the animals are abundant, the species are generally of small size and belong to genera either identical or closely allied to those of the Cretaceous period. The deep sea proper beyond this zone lies upon "a uniform accumulation of thick, adhesive mud, with a variety of worms and such shells as seek muddy bottoms." Professor Agassiz thinks that if the bottom in these depths was rocky, animal life would be "as varied and as numerous comparatively as are the Alpine plants on the very limits of perpetual snow."

With reference to geology, Professor Agassiz says that he infers from the character of the sea bottom that probably none of the layers of stratified rock on the surface of the globe "have been formed in very deep waters," but around the shore lines of the ancient continents, which have been subject only to comparatively slight changes of level after they were once elevated above the primeval ocean.

In the main bearing of this conclusion Professor Agassiz agrees with

* Bulletin of the Museum of Comparative Zoology. No. 13. Report upon Deep Sea Dredgings in the Gulf Stream during the Third Cruise of the U. S. Steamer Bibb; addressed to Professor B. Peirce, Supt. U. S. Coast Survey. By Louis Agassiz. pp. 363-386. Cambridge, 1869.

Dana's theory of the gradual development of continents, a view which of late has been steadily gaining in adherents, especially in this country. The statement, however, that probably no stratified rock has been formed in deep water is open to serious objections. The Chalk, the Nummulitic limestone, the Eozoonal limestone and others of like constitution are composed in great part of Foraminiferous animals especially fitted to flourish at great depths, and, probably, so far as we can judge from soundings and dredgings, covering at the present day a large portion of the Atlantic bottom.

The description of the physical contrast between the shelving of the Florida shore and the abruptness of the Cuban side and Bahama reefs, with the minute analysis of the formation and disintegration of the rocks of the Double Headed Shot Key, Salt Key, and others, will be read with the greatest interest by all geologists. We could not do justice to this part of the publication without quoting several entire pages, and this we have not space for.

Generally speaking the Keys are formed, according to Professor Agassiz, of fine coral sand, which is washed up on to the higher shallower parts, and form banks, upon which accumulate a conglomerate of broken shells, corals and coarse oölithes to the height of high water mark. Upon this foundation rock reposes another accumulation of similar material, distinguished, however, by the steep inclinations of the beds which rise to the height of twelve or fifteen feet. These last furnish the fine material which is swept away by the wind to form sand dunes.

The more homogeneous limestones are formed in the less exposed places, and Professor Agassiz mentions that these are "frequently as hard as the hardest limestone of the secondary formation."

The author then passes to the consideration of the development of Corals, and states that these investigations have led him to regard the *Actinians* as the lowest; the *Madreporarians* next; and the *Halcyonarians* as the highest among the corals. Among the Madrepores the sequence of the genera is *Turbinolia*, *Fungia*, *Astræa* and *Madrepora*. "Young Astræans, before assuming their solid frame, are Actinia-like; their first coral frame is Turbinolia-like, and from that stage they pass into a Fungia-like condition, before they assume their characteristic Astræan features." It is next proved, that the succession of types in geological times, and their bathymetrical distribution from the deepest water to the shallow, corresponds so far as the Madreporarians are concerned to the succession in rank of the adult types as determined by different phases of their development. Thus both as regards rank in classification, and the succession of the different phases of development, as well as the successive appearance of types in the progress of geological time, and the vertical distribution of these types on the seashore, the Turbinolian type is found first and is followed in succession by the Fungian, the Astræan, and the Madreporian types. These views also seem to be in accord with those of Alexander Agassiz, who, as previously cited, com-

pares the deep water Echinoids to the Cretaceous, and those of intermediate depths to Tertiary genera. It would seem, therefore, if the latter be true, that, *a priori*, the former would acquire a still higher degree of probability, so far as the agreement of the succession in time and depth is concerned.

Transactions of the Chicago Academy of Sciences.* — This part completes the first volume of "Transactions" and in interest and value, and the beauty of the plates, fully maintains the high standard of the preceding part. The plates, which are costly, are presented by the Trustees of the Academy, an evidence of their immediate interest in the scientific and literary reputation of their city. Nearly half of the volume is devoted to a biography of Robert Kennicott, the first Director of the Academy, from the pen of Dr. Stimpson, his successor, and the editor of the present volume. It will be read with great interest as the record of a daring explorer and admirable field naturalist.

Dr. J. W. Foster contributes an exceedingly interesting paper "On the Antiquity of Man in North America." Among the proofs of his great antiquity he claims that "the discovery (by Professor Whitney) of a human skull in California during the past season, buried deep in the gold drift, and covered with five successive overflows of lava, carries back the advent of man to a period more remote than any evidences thus far afforded by the stone implements in the drift of Abbeville and Amiens, in the valley of the Somme, or the human skeleton in the loess of the Rhine; and although the fossil elephant (*E. primigenius*) existed in Europe during the glacial epoch, and survived through the valley-drift and loess (which I think may be regarded as contemporary, though different in the form of the materials, and indicating a difference in the transporting power of the current), this association of the remains of the elephant and man has not thus far been found to exist in the purely glacial deposits." He also cites the statement of the late Dr. Koch, that in connection with the remains of the Mammoth found in the Osage valley of Missouri, "were found flint arrowheads and remains of charcoal, as though the aborigines had attacked and destroyed the animal when mired. This statement was received at the time, by the scientific world, with a sneer of contempt. Last spring I questioned him as to the possibility of his having been mistaken, when he assured me, in the most solemn and emphatic manner, that it was true."

He describes the remains of the mound builders, figuring various implements, and recapitulates the evidence of their "advance in civilization beyond a mere barbaric race," as drawn from their textile fabrics, comprising cloth "possessing an uniform and well twisted thread, coarse, and of a vegetable fibre, allied to hemp," and "regularly spun with an uniform thread, and woven with a warp and woof." It was taken from two

* Vol. i, Part II. Chicago, 1869. Royal 8vo, pp. 133 to 337. With a portrait and thirteen plates, mostly colored.

mounds in Ohio. He closes with a chapter on the "Parallelism as to the Antiquity of man on the two Hemispheres." The remaining articles are "Descriptions of certain Stone and Copper Implements used by the Mound Builders," by J. W. Foster, LL.D. "List of the Birds of Alaska, with Biographical Notes," by W. H. Dall and H. M. Bannister. "On Additions to the Bird Fauna of North America, made by the Scientific Corps of the Russo-American Telegraph Expedition," by S. F. Baird, and "A preliminary List of the Butterflies of Iowa," by S. H. Scudder.

GEOLOGY OF THE MISSOURI RIVER VALLEY.* — This is the final report of the interesting series from the able hands of Drs. Meek and Hayden, which have been already published. This Report also includes one made by Dr. Hines on a portion of the route, and another by Professor Newberry, on the Cretaceous and Tertiary plants, already reviewed in the NATURALIST. A careful perusal of the latter, and of Dr. Hayden's chapter on the Physical Geography of the region surveyed would give many of our readers new ideas with regard to their own country. The typographical errors in the work are numerous, since it was printed during the absence of the author, who read no proof of it. The historical introduction reviews the labors of previous explorers, and contains interesting remarks with regard to maps. These are especially opportune as drawing attention to the very fine specimen of map printing which is attached to the present report. The colors are excellent and its size and variety of details gives one a very clear idea of the geological structure of the Great Missouri Valley.

The chapter on physical geography contains a resumé of the results of the barometrical profiles run by the different western government expeditions, showing the general rise of the country west of St. Louis, to the base of the Rocky Mountains. Dr. Hayden regards the whole country west of the Mississippi as a vast plateau, which was gradually elevated to its present height, the strain bursting the central axis of the plateau and giving birth to the numerous chains or parallel ranges of the Rocky Mountains. Dr. Hayden describes only two types of these mountains, those having a granite nucleus and regular outline, and those composed of erupted rocks, which "are very rugged in their outlines and irregular in their trend." The author regards the Black Hills as an example of the regular type, and describes the stratified rocks as lying against the nucleus, or kernel, of granite without a break or any unconformability on either side of the axis of elevation to the latest period of the Cretaceous formation." From these facts we draw the inference that prior to the elevation of the Black Hills, which must have occurred after the deposition of the Cretaceous rocks, all of these formations presented an unbroken continuity over the whole area occupied by these mountains. This is an

* Geological Report of the Exploration of the Yellowstone and Missouri Rivers, by Dr. F. V. Hayden, assistant under the direction of Captain (now Lieut. Col., and Brevet Brig. General) W. F. Raynolds. 1859–60. Washington. 1869. 8vo. pp. 174.

important conclusion, and we shall hereafter see its application by other ranges, and also to the Rocky Mountain range taken in the aggregate."

From evidence of a similar nature the Laramie Mountains, the Big Horn and Wind River Mountains are shown to have been elevated at some time during the Tertiary period.

"In this connection I have thought it best to remark more systematically in regard to the principal rivers that drain this immense area of country. The Missouri River and its tributaries form one of the largest as well as most important hydrographical basins in America. It drains an area of nearly or quite 1,000,000 square miles. Taking its rise in the loftiest portion of the Rocky Mountains, near latitude 44°, longitude 113°, it flows northward in three principal branches, Madison, Gallatin, and Jefferson forks, to their junction, and then proceeds onward until it emerges from the gate of the mountains, a distance of nearly 200 miles; it then bends to the westward, flowing in this direction to the entrance of White Earth River, a distance of nearly 500 miles; it then gradually bends southward and westward to its junction with the Mississippi, a distance of 1,500 to 2,000 miles. The branches which form the sources of the Missouri rise in the central portions of the Rocky Mountain range, flowing through granitic, basaltic, and the older sedimentary rocks until it emerges from the gate of the mountains, when the triassic and jurassic are shown. The falls of the Missouri, extending for a distance of 20 or 30 miles, cut their way through a great thickness of compact triassic rocks. Below the falls the channel makes its way through the soft yielding clays and sands of the Cretaceous beds for about 250 miles, with the exception of the Judith tertiary basin, which is about 40 miles in length. The Cretaceous beds continue extending nearly to the mouth of Milk River, where the lignite tertiary formations commence. These are also composed of sands, marls and clays, as the character of the valley will show. The river flows through these tertiary rocks to the mouth of Heart River below Fort Union, a distance of nearly 250 miles, where the Cretaceous rocks come to the surface again. These latter rocks extend nearly to Council Bluffs, a distance of over 500 miles. I have estimated the distances in a straight line as nearly as possible. Just above Council Bluffs the coal measure limestones commence, and the valley of the Missouri gradually becomes more restricted, though it is of moderate width even below the mouth of the Kansas.

"The Yellowstone River is by far the largest branch of the Missouri, and for 400 miles from its mouth up it seems to be as large as the Missouri itself from Fort Union to Fort Pierre. It is navigable for large steamers during the spring and early summer for 300 to 400 miles above its junction with the Missouri. This river also takes its rise in the main divide of the Rocky Mountains, near latitude 44 1-2° and longitude 110°, in a lake, as some suppose, called Yellowstone lake, which is about 60 miles long and 10 to 20 wide. Its channel is formed in rocks similar to that of the Missouri, about 400 miles of its course passing through lignite tertiary beds. The character of its valley is very similar to that of the Missouri. Most of the important branches of this river I have alluded to in the preceding portion of this chapter. Tongue and Powder Rivers, which are quite long branches, have their origin in the Big Horn Mountains, their channels cutting through the different rocks that surround the Big Horn range. Tongue River is nearly 150 miles in length, and flows for the most part through the soft yielding rocks of the lignite tertiary. Powder River is from 250 to 300 miles in length, and also flows nearly all its course through the same tertiary beds as Tongue River.

Chapter II. on the "System of Geological Formations in the Northwest." Chapter XII. on Geological Explorations in Kansas, and Chapter XIII. "Tour to the Bad Lands of Dakota," in 1866, will be found of especial value to the student of American Geology.

Petites Nouvelles Entomologiques.* — This entomological newspaper published on the 1st and 18th of each month, contains a résumé of news interesting to entomologists, and will be useful to all who wish to keep themselves informed in current entomological information.

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* Subscription (for North America) $1.20 a year post free. All communications to be addressed to Mr. E. Deyrolle, fils, 19 Rue de la Monnaie, Paris. American subscribers can remit in two or three cent postage stamps.

NATURAL HISTORY MISCELLANY.

BOTANY.

Larger Bur-Marigold.—In the last edition of the "Manual," Prof. Gray ascribes to *Bidens chrysanthemoides* a maximum height of two and a half feet. The writer has recently observed this species growing to the prodigious height of from six to eight and two-thirds feet. The locality of these large specimens is near a spring in Pratt Co., Illinois. We tried to trace in these overgrown plants evidences of hybridization with *B. frondosa*, which was growing in the same spot, but could detect none in either leaves, flowers or fruit. Lest the mere record of such a remarkable growth should seem incredible to some, we preserved a specimen measuring eight feet eight inches; stripping it of its branches, of course, except a few terminal ones bearing leaves and flowers sufficient for identification. The species in question almost always surpasses in this district the maximum size allowed it by our authors, as indeed do many other plants. I should add that the specimens of *B. frondosa* of the locality referred to were equally as tall but *not taller* than those of *B. chrysanthemoides*. *Panicum crus-galli* Linn. grows in our low prairies (apparently indigenous) to the height of six or seven feet: and *Lysimachia ciliata* to from three to five, rather than "two to three," as Professor Gray says. But scores of other species might be mentioned which seem constantly to outgrow themselves on our western soils. The flora of the United States as it is now known seems remarkable for various forms of the same species; and although future studies will probably identify as distinct species many forms now regarded as only varieties, yet remarkable differences in the size of the same species in different localities will be a more notable feature of our flora when the plants of the east and the west, the north and the south, shall have been more thoroughly studied and more diligently compared.—Edward L. Greene, *Decatur, Illinois.*

The Yellow-flowered Sarracenia purpurea.—The remarks of Mr. Tracy, on page 327 of the Naturalist, have somewhat surprised me, as the form of *Sarracenia purpurea* L., there described, though rather rare, has been long and well known. (See Gray's Manual, etc.) This is, I presume, no other than the *S. heterophylla* Eaton, and *S. purpurea*, var. *heterophylla* Torr. Under the latter name, Wood, in describing it says it has been found at Northampton, Mass. It may be interesting to state in this connection, as showing its distribution, that I collected this form (a specimen of which I preserve in my herbarium) more than two years ago, on the south shore of Lake Superior, about thirty miles east of Marquette, Michigan. It grew with the common form. In my plant the leaves were without purple veins, or had them but very few and pale.

As to its being a transition state, on its way to full whiteness, that is a point open to question. I do not know that the flower has ever been found white.

Those who so strongly insist on the relation of vital force to color would seem to be sustained in this one fact, that in almost all white varieties (white being taken as absence of color) the foliage, stem, sepals, etc., appear to sympathize, and are at least much paler than usual. But this will not be admitted as conclusive. — HENRY GILLMAN, *Detroit, Mich.*

AREAS OF PRESERVATION. — Although distribution is one of the strongest points of the derivative doctrine, yet it is wonderful to see, in the light of this sober and impartial survey [Bentham's address on Geographical Biology to the Linnæan Society, 1869], how entirely the whole aspect of philosophical natural history in this regard has changed within two decades. "Centres of creation" and the like are of the language of the past, here replaced by Bentham's happy term of "Areas of Preservation." And the conclusion tardily reached "that the present geographical distribution of plants was in most instances a derivative one, altered from a very different former distribution," has been followed by the conviction that the present species themselves are equally derivative, and have a changeful history, some steps in which may be dimly surmised by the study of cognate forms, extant or fossil. At the point now reached, if not by general yet by large consent, the problems we are led to consider are such that it is indispensable to have a term of wider application than "species" technically means; and Mr. Bentham here appropriates to this use the word *Race*, to denote either permanent variety (the old meaning of the word when definitely restricted), or species, or groups of two or more near and so-called representative species, *i. e.*, for those collections of individuals, or resembling groups of individuals, whose association in the way of lineage is taken for granted by this class — or rather by these classes — of naturalists. As the term was only beginning to get fixity in its restricted sense, it will take the wider sense without confusion or difficulty, and with the advantage of a vernacular instead of a newly coined purely technical word. — A. GRAY, *in American Journal of Science.*

LEAVES OF CONIFERÆ. — At the meeting of the Philadelphia Academy of Natural Sciences on the 5th of January, Thomas Meehan referred to his original observations that the so-called leaves of pines were rather branchlets than leaves, and that the true leaves existed in the shape of scales which were adnate to the stem; and that these adnate leaves were partially free or adherent in proportion to the axial vigor of the tree. In some Coniferæ, the larch being a good illustration, the adherent leaves or scales, had the power of producing long foliaceous awns, which appeared as true leaves. Nothing of this kind had been found in Pinus except in the one-year-old or seedling state. He now exhibited a specimen of *Pinus serotina*, which had been sent him by Mr. W. H. Ravenel, of Aiken, South Carolina, in *which foliaceous awns, two inches long, had been*

developed from these adnate leaves, under each fascicle of branchlets (forming 3-*leaved* fascicles). This he thought demonstrated in a more remarkable manner than any observations he had yet made, the soundness of his former deductions.

He called attention to the value of these adnate leaves in affording specific characters. They differed in form and other points nearly as much from one another as the leaves of other tribes or plants. He exhibited living specimens of *Pinus Austriaca*, *P. sylvestris*, *P. maritima*, *P. rigida*, *P. pungens*, *P. mitis* and *P. glabra* Walk., to illustrate this. Some were costate, some regularly plane, others elongated, linear, ovate, obtuse, acute, regular, oblique, spathulate, gibbous, etc., etc. *Pinus glabra*, which had been confused with *P. mitis*, could readily be distinguished by these adnate leaves; and any pine could be as readily known and in some instances better known, by the adnate leaves, than the minute and often almost inappreciable difference founded on the old time leaves (fascicled branchlets) and cones.

NOTES FROM CHICAGO. — Chicago has a flourishing young botanical society, the members of which meet on the first and third Saturday of each month. They have engraved upon their official seal the *Dioscorea villosa*, considering it the prettiest native twiner in this part of the country.

The flowers of the prairies are no prettier than the flowers of New York and Massachusetts. The variety is not so great; but on account of the absence of trees and shrubs some species are represented by very large numbers of specimens, making a grander display which is noticed by everybody. — W. J. B.

PHOTOGRAPHY IN BOTANY. — To illustrate venation and the nature of the surface of foliage photography may be turned to good account, far more than is now commonly thought of. We have seen a photograph from a specimen of one of the coriaceous-leaved oaks of the Dutch Indies which was truly wonderful in its rendering. — A. GRAY, *in American Journal of Science.*

[Photography in Entomology will prove of great benefit, especially in representing, with accuracy, the venation of the wings of the Hymenoptera, Lepidoptera and Diptera. We value very highly certain photographs taken for us several years ago by Professor A. E. Verrill; and Mr. Carl Meinerth of Newburyport, Mass., has taken some exceedingly good pictures of Hymenoptera and Moths. The venation of insects is exceedingly difficult to represent by the pencil, even of a facile and skilled entomologist. — EDITORS.]

TRANSFORMATIONS OF PARTS OF FLOWERS. — Professor Koch has found that in a fruit of *Solanum melongena*, the five anthers have been transformed into five smaller capsules. A capsule of poppy offers, in the centre of its cavity, a small elevation (the continuation of the axis), bearing a number of smaller capsules. — *Nature.*

FERTILIZATION OF PLANTS. — Professor Hildebrand states that plants intermediate between the Papaveraceæ and the Fumariæ gave the greatest quantity of seeds when impregnated with the pollen of another individual of the same species; less when the pollen was taken from another flower of the same individual, and least when the impregnation took place within the flower itself. For *Eschscholtzia Californica*, the proportion of seeds in these three cases was as twenty-four to nine to six. Professor Fewzl says that he obtained abundance of seeds from two species of Abutilon by fecundation with pollen from other individuals, and that these operations are best performed between eight and nine A.M. — *Nature.*

IN FOURS. — In the September number of the NATURALIST, G. F. M. mentions a *Trillium erythrocarpum* having its parts in fours. I have in my collection a similar specimen of *T. sessile*, found on the Salamonie. Also a specimen of *T. recurvatum* from the same locality, having its parts in twos; two leaves, sepals, petals and stigmas, and four stamens.

In the November number, C. J. S. speaks of a specimen of *Zea Mays*, where the floral organs have changed offices. I have often observed this freak in the fields; grains among the staminate flowers, and staminate flowers surmounting the rachis. I have also seen the entire fascicle of staminate flowers transformed into a tuft of little green blades. — R. H. FISHER, *Arba, Indiana.*

ANDROGYNOUS INFLORESCENCE. — Such inflorescences have been found on Zea, Populus, Fagus, Carpinus, *Betula humilis* and *B. alba*, as also on *Pinus nigra*; the small scale, considered as a part of the female blossom, developing itself into an anther. — *Nature.*

ZOÖLOGY.

RELATION OF THE PHYSICAL TO THE BIOLOGICAL SCIENCES. — With reference to those branches of science in which we are more or less concerned with the phenomena of life, my own studies give me no right to address you. I regret this the less because my predecessor and my probable successor in the presidential chair are both of well-known eminence in this department. But I hope I may be permitted, as a physicist, and viewing the question from the physical side, to express to you my views as to the relation which the physical bear to the biological sciences.

No other physical science has been brought to such perfection as mechanics; and in mechanics we have long been familiar with the idea of the perfect generality of its laws, of their applicability to bodies organic as well as inorganic, living as well as dead. Thus in a railway collision, when a train is suddenly arrested the passengers are thrown forward, by virtue of the inertia of their bodies, precisely according to the laws which regulate the motion of dead matter. So trite has the idea

become that the reference to it may seem childish; but from mechanics let us pass on to chemistry, and the case will be found by no means so clear. When chemists ceased to be content with the mere ultimate analysis of organic substances, and set themselves to study their proximate constituents, a great number of definite chemical compounds were obtained which could not be formed artificially. I do not know what may have been the usual opinion at that time among chemists as to their mode of formation. Probably it may have been imagined that chemical affinities were indeed concerned in their formation, but controlled and modified by an assumed vital force. But as the science progressed many of these organic substances were formed artificially, in some cases from other and perfectly distinct organic substances, in other cases actually from their elements. This statement must indeed be accepted with one qualification.

It was stated several years ago by M. Pasteur, and I believe the statement still remains true, that no substance, the solution of which possesses the property of rotating the plane of polarization of polarized light had been formed artificially from substances not possessing that property. Now several of the natural substances which are deemed to have been produced artificially are active, in the sense of rotating the plane of polarization, and therefore in these cases the inactive artificial substances cannot be absolutely identical with the natural ones. But the inactivity of the artificial substance is readily explained on the supposition that the artificial substance bears to the natural the same relation as racemic acid bears to tartaric; that it is, so to speak, a mixture of the natural substance with its image in a mirror. And when we remember by what a peculiar and troublesome process M. Pasteur succeeded in separating racemic acid into the right-handed and left-handed tartaric acids, it will be at once understood how easily the fact, if it be a fact, of the existence in the natural substance of the mixture of two substances, one right-handed and the other left-handed, but otherwise identical, may have escaped detection. This is a curious point, to the clearing up of which it is desirable that chemists should direct their attention. Waiving then the difference of activity or inactivity, which, as we have seen, admits of a simple physical explanation, though the correctness of that explanation remains to be investigated, we may say that at the present time a considerable number of what used to be regarded as essentially natural organic substances have been formed in the laboratory. That being the case it seems most reasonable to suppose that in the plant or animal from which those organic substances were obtained they were formed by the play of ordinary chemical affinity, not necessarily nor probably by the same series of reactions by which they were formed in the laboratory, where a high temperature is commonly employed, but still by chemical reactions of some kind, under the agency in many cases of light, an agency sometimes employed by the chemist in his laboratory. And since the boundary line between the natural substances which have, and those which have not,

been formed artificially is one which, so far as we know, simply depends upon the amount of our knowledge, and is continually changing as new processes are discovered, we are led to extend the same reasoning to the various chemical substances of which organic structures are made up.

But do the laws of chemical affinity, to which, as I have endeavored to infer, living beings, whether vegetable or animal, are in absolute subjection, together with those of capillary attraction, of diffusion, etc., account for the formation of an organic structure, as distinguished from the elaboration of the chemical substances of which it is composed? No more, it seems to me, than the laws of motion account for the union of oxygen and hydrogen to form water, though the ponderable matter so uniting is subject to the laws of motion during the act of union just as well as before and after. In the various processes of crystallization, of precipitation, etc., which we witness in dead matter, I cannot see the faintest shadow of an approach to the formation of an organic structure, still less to the wonderful series of changes which are concerned in the growth and perpetuation of even the lowliest plant. Admitting to the full as highly probable, though not completely demonstrated, the applicability to living beings of the laws which have been ascertained with reference to dead matter, I feel constrained, at the same time, to admit the existence of a mysterious *something* lying beyond — a something *sui generis*, which I regard, not as balancing and suspending the ordinary physical laws, but as working with them and through them to the attainment of a designed end.

What this *something*, which we call life, may be, is a profound mystery. We know not how many links in the chain of secondary causation may yet remain behind; we know not how few. It would be presumptuous indeed to assume in any case that we had already reached the last link, and to charge with irreverence a fellow-worker who attempted to push his investigations yet one step farther back. On the other hand, if a thick darkness enshrouds all beyond, we have no right to assume it to be impossible that we should have reached even the last link of the chain; a stage where farther progress is unattainable, and we can only refer the highest law at which we stopped to the fiat of an Almighty Power. To assume the contrary as a matter of necessity, is practically to remove the first cause of all to an infinite distance from us. The boundary, however, between what is clearly known and what is veiled in impenetrable darkness is not ordinarily thus sharply defined. Between the two there lies a misty region, in which loom the ill-discerned forms of links of the chain which are yet beyond us. But the general principle is not affected thereby. Let us fearlessly trace the dependence of link on link as far as it may be given us to trace it, but let us take heed that in thus studying second causes we forget not the first cause, nor shut our eyes to the wonderful proofs of design which, in the study of organized beings especially, meet us at every turn. — *President Stokes' Address to the British Association.* SCIENTIFIC OPINION.

Notes on the Ducks found on the Coast of Massachusetts in Winter. — [A sporting friend in Salem sends the following interesting notes on our winter ducks, which, though differing somewhat from the published opinions of some writers, accord in the main with notes in previous lists of the birds of Massachusetts. While adding to our ornithological record many facts of special interest in respect to the distribution of our ducks in winter, they are also important as confirmatory in the main of what has been previously written]: On looking over the "List of New England Birds" I find some statements that are not in accordance with my own experience as a sportsman.

Mallard (*Anas boschas* Linn.). "Winter resident; not abundant." This is not a diving duck, but feeds the same as our tame ducks, and is usually found in fresh waters. I have never seen it here in winter. Perhaps a bird wounded in the fall may stay over, but *I* never saw any in winter. They are not plenty even on the Chesapeake waters after the last of November, but go still farther south. A *few* may be shot on the Jersey marshes in winter.

Pintail Duck (*Dafila acuta* Jenyns). "Chiefly along the coast. Winter resident; not abundant." I have never found one of these ducks here in winter. This is also not a duck that dives for its food (and hence cannot feed in deep water). It is usually a very timid duck, and constantly on the watch. On the Delaware, in spring, considerable numbers are shot. By some it is called Spring-tail.

Scaup Duck (*Fulix marila* Baird). "Winter resident." I never saw one of these here in winter. Some are found at that season in Long Island Sound and on the south side of Long Island. A few also winter on the south side of Cape Cod.

Red Head (*Aythya Americana* Bon.). "Winter resident." None to my knowledge winter here. They are a strong diver, and can get their food even in winter, if they will eat the same kind of food that our Coot and Old Squaw live on.

Canvasback (*Aythya vallisneria* Bon.). "Chiefly winter resident; not abundant." Very seldom if ever seen in our waters. A very few have been shot. A few may be found in the waters near New York.

Golden Eye (*Bucephala Americana* Baird). "Common winter resident." Winters from Florida to Maine. There are always large numbers to be seen any calm day in winter from our lower gunning house on Rowley River.

Buffel Head (*Bucephala albeola* Baird). "Abundant winter resident." Stay late in fall and come early in spring; but few, if any, winter here.

Black Duck (*Anas obscura* Gm.). "Resident." There is a *small* variety of this duck that always winters with us and can be procured at any time when the weather is favorable, from September to April. But in early spring the more southern ducks of this species come north and stop a little time here. They are considerably larger than those that winter in our bays. The ducks of this species usually spend the day at sea and

return towards evening to the flats and marshes to feed, for they are not a duck that dives for its food, but tilt up as our puddle ducks do when feeding.

All the species here mentioned may have been seen and shot by others, but so far as I have observed only Coots, Eiders, Black Ducks, Velvet Ducks and Scoters winter here. Since most ducks are strong fliers, capable of travelling forty to sixty miles an hour, it would take but about one night's flight for them to reach us from Long Island Sound or even the Delaware waters, and a few warm days may be sufficient to tempt some here, now and then, that are not probably winter residents, a fact that may have been overlooked by some who may have observed certain of them here in winter.

Is Huxley's Bathybius an Animal? — In the "Microscopical Journal" for October, 1868, is a memoir by Professor Huxley, "On some organisms living at great depths in the North Atlantic Ocean," in which he states that the stickiness of the deep-sea mud is due to "innumerable lumps of a transparent gelatinous substance," each lump consisting of *granules, coccoliths*, and *foreign bodies*, embedded in a transparent, colorless, and structureless matrix." The granules form heaps which are sometimes the one-thousandth of an inch or more in diameter. The "granule" is a rounded or oval disc, which is stained yellow by iodine, and is dissolved by acetic acid. "The granule heaps *and* the transparent gelatinous matter in which they are embedded, represent masses of protoplasm." One of the masses of this deep-sea "urschleim," may be regarded as a new form of the simplest animated beings (*Moner*), and Huxley proposes to call it *Bathybius*. The "*Discolithi* and the *Cyatholithi*," some of which resemble the "granules," are said to bear the same relation to the protoplasm of *Bathybius* as the spicula of sponges do to the soft parts of those animals; but it must be borne in mind that the spicula of sponges are embedded in a matrix, which is formed by and contains, beside the spicula, small masses of living or germinal matter. As in other cases, this matrix, with the living matter included, constitutes the "protoplasm" of Mr. Huxley.

Dr. Wallich has, however, arrived at a very different conclusion. In a paper "On the Vital Functions of the Deep-sea Protozoa," published in No. 1 of the "Monthly Microscopical Journal," January, 1869, this observer, who has long been engaged in this and kindred studies, states that the coccoliths and the coccospheres stand in no direct relation to the protoplasm substance referred to by Huxley, under the name of *Bathybius*. The former are derived from their parent coccospheres, which are independent structures altogether. "*Bathybius*," instead of being a widely extending *living* protoplasm which grows at the expense of inorganic elements, is rather to be regarded as a complex mass of slime with many foreign bodies and the *debris* of living organisms which have passed away. Numerous living forms are, however, still found on it.

Dr. Wallich is of opinion that each coccosphere is just as much an independent structure as *Thalassicolla* or *Collosphæra*, and that, as in other cases, "nutrition is effected by a vital act," which enables the organism to extract from the surrounding medium the elements adapted for its nutrition. These are at length converted into its sarcode and shell material. In fact, in these lowest, simplest forms we find evidence of the working of an inherent vital power, and in them nutrition seems to be conducted on the same principle as in the highest and most complex beings. In all cases the process involves, besides physical and chemical changes, purely *vital actions*, which cannot be imitated, and which cannot be explained by physics and chemistry. — LIONEL BEAL. *in Monthly Microscopical Journal.*

REASON AND INSTINCT. — Under this title Sir S. W. Baker, devotes a chapter of his "Eight Year's Wanderings in Ceylon," to symptoms of the reasoning faculty in animals, and narrates a story of his hound "Bluebeard," which was called to mind by your account of the Spider and Mud-wasp on page 391 of the September NATURALIST. To condense a little, the facts were these: "Sir Samuel was hunting in a rolling country divided by jungles into so-called patinas, with a large and deep river flowing through the centre. The pack had disappeared, but after a long time spent in searching for them, Sir Samuel saw from one of the grassy knolls that commanded the patina, an elk swimming out from the jungle, and succeeded with the gray hounds, remaining by him, in running her down shortly after she landed:

"We were cutting up the elk, when we presently heard old Bluebeard's voice far away in the jungle, and, thinking he might perhaps be running another elk, we ran to a hill which overlooked the river, and kept a bright lookout. We soon discovered that he was true upon the same game, and we watched his plan of hunting, being anxious to see whether he could hunt upon an elk that had kept to water for so long a time.

On his entrance to the patina by the river's bank, he immediately took to water and swam across the stream: here he carefully hunted the edge for several hundred yards down the river, but, finding nothing, he returned to the jungle at the point from which the river flowed. Here he again took to water, and, swimming back to the bank from which he had at first started, he landed and made a vain cast down the hollow. Back he returned after his fruitless search, and once more he took to water. I began to dispair of the possibility of his finding; but the true old hound was now swimming steadily down the stream, crossing and recrossing from either bank, and still pursuing his course down the river. At length he reached the spot where I knew that the elk had landed, and we eagerly watched to see if he would pass the scent, as he was now several yards from the bank. He was nearly abreast of the spot, when he turned sharp in and landed in the exact place: his deep and joyous note rung across the patinas, and away went the gallant old hound in full cry upon the scent, while I could not help shouting, 'Hurrah for old Bluebeard!' In a few minutes he was by the side of the dead elk — a specimen of a true hound, who certainly had exhibited a large share of reason.'" — P.

MALFORMATIONS IN INSECTS. — In the summer of 1868 I observed on several occasions along the south shore of Lake Superior, specimens of the Dragon-fly with a curious malformation, or arrest of development of the wing. In an individual I specially observed, the skin had just been cast, and the wings, not having yet hardened, were quite soft and delicate to the touch. In one of the wings was a lump-like unexpanded portion reducing the size of the limb nearly one-half. The malformation was

similar in each of the instances noticed by me, and was so serious as to prevent the flight of the insect, it invariably falling to the ground on being thrown into the air, and being quite unable to raise itself.

A like deformity, with like results, I had previously found to be not uncommon in the Ephemera, which is produced in such countless multitudes in the lake region. The only wonder is that creatures so fragile that almost the touch of a finger injures them, should be brought into existence in such myriads, generally unharmed and perfect.

I saw two examples of a more singular case of malformation in the beautiful pale green Moon-moth (*Actias Luna*). The wing was similarly dwarfed or contracted, a large portion towards the extremity being unexpanded and hardened. The coloring matter and fluids which should have passed down to perfect the development remained above in greenish blisters, protruding the skin of the wing on each side. On breaking this the contents escaped. By pressing those blisters it was possible to project the colored fluid in any direction within the wing; the motions being quite perceptible in the increased brilliancy of color of the parts where the fluid passed. — HENRY GILLMAN, *Detroit, Michigan.*

THE COTTON OR ARMY WORM OF THE SOUTH. — The Secretary (of the Entomological Society of London) read a communication respecting the injury done to the cotton crop in Louisiana by the "Army Worm," the larva of *Heliothis armigera* (undoubtedly the *Anomis xylina*. Eds.)

"It stated that the crop was in danger of being entirely eaten up. Some years ago the planters of Louisiana, tempted by the high price of cotton, which was then selling at fifteen pence a pound, began to cultivate cotton, which had been almost abandoned. The sugar-cane became of secondary importance; but the caterpillars arrived, and swept away the hopes of the planters in a few days The noise made by the multitudes of the voracious insects was described as audible at the distance of a mile, and to resemble the crackling of a house on fire. It was thought for a long time that the Army worm only visited Lower Louisiana, but this was an error; in 1788, these insects destroyed two hundred and eighty tons of cotton in the Bahamas; they caused the cultivation of cotton to be given up in many of the West Indian Islands, and the case was almost the same in Egypt; in 1793 this insect visited Georgia, and in 1800 it ravaged South Carolina; four years later they descended on the whole of Louisiana; and in 1825 they ravaged the whole of the Southern States, and it was very difficult even to get seed for the following year. The last general visitation was in 1845. The Army worm appears often in Guiana and other parts of South America."

BLACKBIRDS IN WINTER. — Since the first week in December there have been two, and part of the time three, Rusty Blackbirds constantly about one of my barns. At the same locality a number of Cow Blackbirds were seen last winter and the winter before. They appeared about the middle of November, and left the last of March. Sometimes only three or four were observed, but the highest number seen was nineteen. They were usually very tame, allowing one to approach within eight or ten feet of them. Their only note was a sort of a whistle, uttered while sitting on the top of an apple-tree. The Cow Blackbirds were usually very active, but the Rusty Blackbirds seemed much pinched with cold, and in cold days sat crouched down on their feet. — ROBERT HOWELL, *Nichols, Tioga County, N. Y.*, Jan. 11, 1870.

How the Sculptured Turtle (*Glyptemys insculpta* Ag.) deposits her eggs. — [The following was given to me by Mr. Frank Gammons, of West Newton. I think it exceedingly interesting, and send it for publication. — C. J. M.]

I was passing through a cornfield in Weston, when I observed a turtle scratching about a hill of corn with one of her forefeet. I paused and watched her movements. She went to half a dozen or more hills, and seemed to try them, but for some reason they did not suit her; finally she came to one where she began to dig in earnest with both forefeet; turning around with her hind-feet acting as a pivot she continued to dig until she had formed a complete circle with the dirt thrown in the centre. She then reversed her position by placing her forefeet in the centre and *supporting herself by these alone*, she with her hind-feet threw out the earth; at the same time turning around until the hole was about six inches deep and about thirteen inches in diameter. She then began to tread it down hard on the bottom. She then came out to the edge and immediately deposited eighteen eggs, with the space of about a minute between each deposit. Sometimes two would come out very nearly together. When she had finished laying she filled the hole by standing on her forefeet as before, and using her hind ones as shovels. When about one inch of earth was thrown in, she would get in and tread it solid. This continued until the hole was filled, when, after smoothing and treading carefully, she crawled away. She measured nine inches wide by twelve long. The soil where she dug was very sandy.

Anecdote of the Sparrow-hawk. — An old gentleman once told me the following incident of this bird and I can vouch for its truth: "One day as I was sitting by my window looking over the thriving little town of D———, my attention was turned towards a tame cat which was crossing the street, and bearing a large mouse in her mouth, evidently a treat for her young. But she came well nigh losing it, for a sparrow-hawk came flying over, and seeing the mouse in her mouth, made a sudden swoop and tried to seize it with its talons, but did not succeed. The hawk continued its attempts until they reached the opposite side of the street, when the cat disappeared under the sidewalk, and the hawk flew off into the forest." — T. Allison, *De Witt, Iowa.*

Hybrid Fowls. — By chance I have had in my possession for two or three years a pair of hybrid fowls, bred from an ordinary dung-hill cock and a guinea hen. Not having had the means of ascertaining whether this is an isolated instance worthy of note, I have addressed these few lines to you, since if the case is worthy of attention I shall be pleased to give you any information concerning them that is in my power. — Ward Bachelor, *Waverly, Pa.*

[If not too late we should be pleased to have a description of the fowls. Will our readers inform us of any similar cases they may have authentic knowledge of. — Eds.]

THE RUBY-CROWNED KINGLET. — All our standard works on American ornithology describe the Ruby-crowned Kinglet as presenting little or no sexual differences in color, both males and females being said to possess the red crest when mature; those without it being regarded as young or immature birds. I have long questioned whether this is so, but have not of late had an opportunity of arriving at a satisfactory conclusion. Mr. Jillson, writing to me recently about them, says he thinks there is some mistake about them. He says "as far as I know, all naturalists describe the female as having the red on the head. I have taken from three to a dozen every season in May; have dissected most of them but have never found one that had the red that was not a male. I have never taken any without the red until after the former had all, or nearly all, gone north. Those without the red have always proved to be females, and I have never heard one of them sing; but I do not think I ever shot one with the red crown but that I had heard it sing."

What now is the experience of others? Does the female ever have the red crown? — J. A. ALLEN.

THE CROCODILE IN FLORIDA. — Professor Wyman describes, in the "American Journal of Science" for January, the skull of a true Crocodile shot near the mouth of the Miami River, Florida. He remarks that "it has been shown by different paleontologists, especially by Dr. Leidy and Professor Cope, that several species of Crocodilians existed in North America during the Cretaceous and Miocene periods, all of which became extinct. At the present time two living species of true Crocodiles, viz: *C. acutus* and *C. rhombifer*, are known in South America, and both range as far north as Cuba and San Domingo, but we have not been able to find a record of the presence of either of them within the limits of the United States, the Alligator being the only representative of the family to which it belongs." He considers the Florida specimen as the *Crocodilus acutus*.

HOUSE SPARROW (*Passer domesticus*). — The recent introduction of this interesting and useful little foreigner to Boston, with a view to his naturalization and domestication throughout our New England States, appears, I opine, in a fair way of accomplishment, and to call for some notice and gratulation. Although we cannot restrict him to city life, it is certain that he will instinctively discover for himself locations suitable to his peculiar habits and economy. Already he has appeared in some of the suburban towns. In passing a few days since through one of the most frequented streets of this village, I was unexpectedly surprised and gratified in recognizing a merry party of six of our new English friends of both sexes; some picking out the half digested grain among the horse droppings on the road; others, merrily chirping and arranging their toilets on the trees of an adjacent pear orchard, among which a quantity of loose stable litter had been strewn; in such circumstances they appeared to be quite at home and vastly enjoying themselves. He is a social, bold, cunning and gregarious bird; domestic, yet impatient

of restraint, and his loquacity and pugnacious disposition are at times quite amusing, and if successfully acclimated, we may expect eventually to find him generally dispersed among our villages and farmsteads, as well as on the crowded streets of our cities, where his presence may be encouraged and his person protected by wise and salutary laws. Some little attention to his natural wants during our usually severe and protracted winters, when the earth is bound by frost or enveloped with snow, in the shape of a few daily handfuls of grain and a snug shelter under the eaves of the barn or outhouse, would, I apprehend, be the extent of his demands on our sympathies, and with his cheerful company and active service during the ensuing season in exterminating those insectivorous pests of the garden and orchard, the curculio, cankerworm (*Et sui generis*), would be found an ample remuneration, and a more plentiful supply of sound apples and luscious plums we might expect as one of many other beneficial results. — J. R. COLLETE, *Somerville, Mass.*

DIMORPHISM IN THE HIGHER WORMS. — The distinguished Swiss naturalist, M. Claparède, in a recent article: "Researches on the Annelids," published in the "Bibliothèque Universelle, Archives des Sciences Physiques et Naturelles," gives an abstract of his studies of the annelids of the Gulf of Naples, in which he confirms the discovery of Malmgren (noticed in the NATURALIST, Vol. iii. p. 494) that Heteronereis is a form of the old genus Nereis. He states that Ehlers, in 1867, in his "Die Borstenwürmer," a work on the higher annelids, has shown the undoubted specific unity of *Nereis cultrifera* and *Heteronereis lobulata*; of *Nereis pelagica*, and *Heteronereis grandifolia*; of *Nereis Dumerilii* and *Heteronereis fucicola*; of *Nereis vexillosa*, and *Heteronereis Middendorfii*; of *Nereis fucata* and *Heteronereis glaucopis*, and another Heteronereis form to *Nereis Agassizii* and *Nereis virens*. He thinks the Nereids are transformed into Heteronereids at the time of sexual maturity. Claparède states, however, that all the species of Nereis do not have a Heteronereid form, as the species of Nereis far exceed in number those of the so-called genus Heteronereis.

He thus concludes: "The fact of animals presenting two sexual forms is not entirely new. The beautiful observations of M. M. Leuckart and Mecznikow, and those of M. Schneider on the *Ascaris nigrovenosa*, have made us acquainted with analogous cases among the Nematodes, where one of the generations, it is true, is hermaphrodite, and the other presents separate sexes. But, among the Acalephs, certain Geryonidæ (*Carmarina*), according to M. Haeckel, and among the Nematodes, the *Leptodera appendiculata*, according to M. Claus, present two sexual forms, for each of which '*gonochorisme*' is the rule. The history of the Axolotls, which M. Dumeril has acquainted us with, offers certain points of analogy with that of *Nereis Dumerilii*."

The bearing of these remarkable discoveries, as well as those of the dimorphic forms of insects, on Darwinism, and especially Professor Cope's theory of the origin of genera, is startling, and strongly confirmatory of the latter phase of the theory of evolution.

DISPOSAL OF THE PLACENTA. — Noticing in the NATURALIST passing allusions to this subject, I desire to add my testimony in the case. I have closely observed cats and dogs in the act of parturition, and am in position to affirm that these animals devour the afterbirth. It would rationally be inferred from the fact that a cat's bed, no matter how numerous her progeny, shows nothing but a few blood stains, and those made by the liquor amnii. The lying-in of a bitch that I watched through the whole process, and had under observation for some days afterward, furnished some other interesting particulars. The uterus expelled its contents at short intervals, one fœtus at a time, each emerging entire, without rupture of the membranes, and so of course, accompanied by the secundines intact. The mother at once seized the fluctuating mass with her teeth, tore it open, spilt the water, and shook out the puppy. She then hastily took the placenta and membranes in her mouth, chewing and swallowing convulsively until the whole mass was in her throat, the funis meanwhile hanging out of her mouth with the puppy still attached, its abdomen touching her muzzle. At this point she began to bite the cord, about an inch from the umbilicus, and chewed it off, using not the incisor, but the canine teeth. A few drops of blood followed the severing of the cord; the puppy was left to its own resources, while the mother rested, apparently asleep, after her pain and fatigue. The process was substantially repeated in each instance. In this accouchment there were nine puppies; consequently some idea of the amount of flesh taken into the mother's stomach may be formed.

Here are two points for consideration. In the mode of severing the cord we have a fine example of the instinct, or perhaps rather necessity, that effects laceration, instead of clean cutting, and thus obviates hemorrhage; for lacerated vessels do not bleed. It raises a question now extensively discussed by obstetricians; and, indeed, one might ask with propriety, was Cain's navel-string tied? Secondly, it is probable that the secundines are not wasted, but on the contrary furnish sustenance to the mother for a time. In the case to which I have special reference the mother did not leave her bed for forty-eight hours, nor could she be induced to take food brought to her during that time. The mass was certainly digested, and its nourishment assimilated, as was evident from the appearance of what was voided on the third day. — ELLIOTT COUES.

SUMMER RED BIRD.—I have just learned, through Mr. Winfield Stearns, of Amherst (in a letter to the NATURALIST), that a specimen of the Summer Red Bird (*Pyranga æstiva*), was shot in August, 1867, in that town, this making the third instance now known of the capture of this southern bird in this state.

Much is doubtless still to be learned respecting our Massachusetts birds, especially in regard to the frequency of occurrence of many of the rarer species. It is to be hoped that those having facts of interest respecting such species will see fit to report them in the NATURALIST. — J. A. ALLEN.

THE OSPREY (*Pandion haliaëtus*). — Mr. Allen, on page 569 of Vol. iii of the NATURALIST, refers to the desertion of the seaboard of Massachusetts by this bird. I will relate an incident which came under my observation some time since showing that the Osprey is still, or recently, a very near neighbor and affording some expectation of his return to our coasts where conditions suitable to his peculiar habits still exist.

Walking from Bristol to Warren, R. I., in May, 1868, I noticed with a pleasant surprise an eyrie of a pair of these birds on the denuded top of a stunted oak or butternut, at an elevation, judging from my distance, of less than twenty feet from the ground, located near a solitary farmstead, about half a mile distant on the right of the turnpike, and with but few other trees of dwarfish growth scattered at intervals around. The female bird appeared to be busily engaged in collecting material and repairing her nest; the male meanwhile sedulously pursuing his piscatory avocation over the adjacent bay. I presume I could not have been mistaken in identifying the species on this occasion, having had some years previous a fair opportunity of studying the habits of these birds on the estate of my friend, Dr. Parmley, near Shrewsbury Inlet, New Jersey. — J. R. COLLETE, *Somerville, Mass.*

THE GREAT AUK. — The statement (Amer. Nat., iii, p. 539) that "the Great Auk or Gare-fowl, fortunately for itself did not live long enough to receive more than one scientific name" is incorrect. I give several (Proceedings of the Academy of Natural Sciences, Phila., 1866), and believe others might be found. The tips of the wings are not white, as stated (l. c.), the primaries not being thus marked. I should judge "less than thirty specimens of the egg . . . . now preserved" (op. cit. p. 550), to be an underestimate. Mr. Robert Champley (Annals Mag. Nat. Hist., 1864, p. 235—fide Hartl. Jahrest. 1864, p. 27), records fifty-three. Those who hesitate to credit comparatively southern localities for the species should consult the paper of one of the highest authorities upon the subject, Professor A. Newton. (Ibis, Oct., 1862). Some of Nuttall's observations are more poetical than reliable. Lastly, we have no proof that the Great Auk is extinct; the negative evidence in the case is not so weighty that Professor Newton could not say with propriety "I think there is yet a chance of the Great Auk still existing" (ibid., p. 23). — ELLIOTT COUES.

A RARE VISITOR. — A specimen of Pomarine Jager (*Lestris Pomarina*), was obtained by Mr. Vincent Barnard on the fourth of July last, on the Susquehanna River at Peach Bottom, Lancaster County, Penn. An adult bird of the same species was procured, during the summer of 1840, at Harrisburg on the same river by Professor Baird. When it is remembered that adults of this species seldom come within the limits of the United States, even in the severest winters, young birds only making their appearance along the New England Coast, their occurrence in midsummer may well be considered as quite remarkable. ***

THE COW BIRD.—In the second number of "Nature," Professor Newton has an uncommonly interesting and suggestive article on the variation observed in Cuckoos' eggs, which seems to depend upon, or to be in some way connected with the characters of the eggs of the birds selected by the parasite as the foster-parents of its offspring. Has anything of the sort been determined regarding the eggs of the Cow-bird? Do they vary, in the first place, to anything like the extent that the Cuckoo's do; and secondly, do they ever tend unmistakably to assimilate in marking to the eggs of birds usually selected by the Cow-bird as its dupes? Or, again are the birds so chosen, those whose eggs have any special resemblance to a Cow-bird's? It is not always so, I know; but is it so sometimes, frequently, or usually? The subject is worthy of the attention of our ornithologists, from whom it would be well to hear.—ELLIOTT COUES.

OCCURRENCE OF THE BROWN PELICAN IN MASSACHUSETTS.—Since writing "Notes on Some of the Rarer Birds of Massachusetts," I have received, through the kindness of Mr. Martin, further information respecting the Pelicans mentioned in the February number of the NATURALIST. The gentleman who saw the flock referred to there, and who fired at them, writes that the number was five instead of thirteen, as at first erroneously reported, and that they were the *smaller brown species* (*Pelecanus fuscus*) instead of White Pelicans. They came in from the sea, apparently much fatigued, and alighted on the beach near the Sankaty Head lighthouse, where they remained till driven away by being fired at. A White Pelican seems, however, to have been recently killed on Brant Point, Nantucket, as previously stated. The Brown Pelican I have not known to occur previously so far north.—J. A. ALLEN.

THE CHIPMUNK.—One of our chipmunks was noticed a few days ago busily nibbling at a snake that had been recently killed. He could hardly be driven away, and soon returned to his feast when his tormentors had withdrawn a short distance. Does the *Tamias striatus* in other regions possess such carnivorous propensities?—A. J. COOK, *Lansing, Mich.*

ALBINO RODENTS.—In the back yard of a small restaurant in this city is kept a beautiful albino squirrel, of the black and gray species (*Sciurus Carolinensis* Gm.). It was taken in Central Wisconsin, where another was killed at the same time. There is an albino rat at a bird-store in town.—W. J. BEAL.

CONCHOLOGICAL SECTION OF THE ACADEMY OF NATURAL SCIENCES, PHILADELPHIA, *Nov.* 4th, 1869.—Mr. Tryon called the attention of the members to specimens of *Amnicola grana* Say, from Carter County, Missouri, presented this evening. This very minute species was apparently unknown to Professor Haldeman, who in his monograph of the genus, merely quotes Say's original description and citation of locality and does not figure it. The species was for years considered a doubtful one, until Mr. Tryon had discovered it, six or eight years ago, existing in considerable numbers in ditches in the southern part of the city of Philadelphia.

Mr. T. distributed specimens to many of the American Conchologists, most of whom informed him that it was new to their collections. The donation this evening (Nov. 4) indicates that the species has a large area of distribution, and has probably been overlooked by collectors under the supposition that it was merely the young of some larger species.

At the meeting held December 2d, Mr. W. L. Mactier called attention to a specimen of *Dolium melanostoma* Jay, presented by him this evening. The locality of this shell still remains a mystery, although it has been recently assigned to Japan. Mr. M. also presented a nearly perfect specimen of *Voluta Junonia* and remarked that it was the rarest of American *Volutidæ*, and was found in the Gulf of Mexico.

Mr. Tryon referring to his remarks made at a former meeting in refutation of Dr. Gray's opinion that *Crepidula plana* Say, is identical with *C. fornicata* Linn., stated that additional evidence of their non-identity had recently been presented by Mr. George H. Perkins, who in a recent paper states "that the ovi-capsules of *plana* are broader, shorter, and thinner than those of *fornicata*, and the ova are differently situated."

GEOLOGY.

Further Evidence of the Affinity between the Dinosaurian Reptiles and Birds. — Professor Huxley reviewed the evidence already cited by himself and others (especially Prof. E. D. Cope), in favor of the ornithic affinities presented by the Dinosauria; and discusses at length the recently ascertained facts which bear upon this question, some of the most important of which are derived from the species described by him in the preceding paper under the name of *Hypsilophodon Foxii*. He summed up his paper by a comparison of the different elements of the pelvic arch and hinder limb in the ordinary reptiles, the Dinosauria and Birds, and maintained that the structure of the pelvic bones (especially the form and arrangement of the ischium and pubis), the relation between the distal ends of the tibia and the astragalus (which is perfectly ornithic), and the strong cnemial crest of the tibia and the direction of its twist, furnishes additional and important evidence of the affinities between the Dinosauria and Birds.

Sir Roderick Murchison, who had taken the chair, enquired as to the habits of the Hypsilophodon. Mr. Hulke mentioned that Mr. Fox had several blocks containing remains of a large portion of the Hypsilophodon, all procured from a thin band of sandstone near Cowleaze Chine. On one the pelvis is almost entire, as well as the right femur, the tibia, which is longer than the femur, four long metatarsal bones, and an astragalus. All the long bones are hollow. Portions of at least eight individuals have been found in the same bed. Mr. Seeley doubted whether these animals should be called reptiles at all, as they seemed to him to form a group distinct alike from reptiles, birds, and mammals, but occu-

pying an intermediate position. In the hinder limbs of Pterodactylus the analogies were closer with mammals than with birds. He thought it possible that the peculiar structure of the hinder limbs of the Dinosauria was due to the functions they performed rather than to any actual affinity with birds. The President, in reply, stated that Hypsilophodon, from the character of its teeth, probably subsisted on hard vegetable food. He expressed a hope that Mr. Fox would allow a closer examination of his specimens to be made. He was unable to agree with Mr. Seeley's views. He was inclined to think that the progress of knowledge tended rather to break down the lines of demarcation between groups supposed to be distinct than to authorize the creation of fresh divisions. — *Nature, London.*

Fossil Horse in Missouri. — In the Transactions of the St. Louis Academy of Science (Vol. ii, p. 418), Professor Swallow announced the discovery of horse remains in the altered drift of Kansas.

I have now the honor to announce that similar remains have recently been discovered in a well at Papinville, Bates County, Missouri. Mr. O. P. Ohlinger procured a tooth at the depth of thirty-one feet from the surface, resting in a bed of sand beneath a four inch stratum of bluish clay and gravel. Above the last was thirty feet ten inches of yellowish clay reaching to the surface. Beneath the sand, containing the tooth, was a gravel bed five feet in thickness, consisting mostly of rounded pebbles resembling river gravel, generally hornstone, many partially, and some firmly adhering together. Other pebbles shown me from the same bed were of iron ore, coal and micaceous sandstone. I was farther informed that some remains of fluviatile shells were found. I sent the tooth to Professor Joseph Leidy of Philadelphia, and he pronounced it to be the last upper molar of a horse, probably an extinct species.

From a similar gravel bed on the banks of Marais des Cygne, a fragment of a tusk was given me resembling very much that of a mammoth. Its whole length was said to be seven feet four inches. About ten miles above Papinville, the banks of Marais des Cygne River appear to be of a similar formation to the well of Ohlinger, consisting of about twelve feet of brown sandy clay resting on ten feet of blue clay with many pebbles of worn gravel at the lower part.

These gravel beds I consider as of more recent age than the drift, but older than the bluff or loess, and regard them as altered drift. They seem rather to abound on the Osage and its tributaries, and are often reached in digging wells.

The tooth from Maysville, Kansas, was found in altered drift at a depth of forty-five feet from the surfaces.

Dr. Albert Koch exhumed the famous *Missourium* (*Mastodon giganteus*), from a bed of gravel and clay on Pomme de Terre River, twenty feet below the surface. In these beds of altered drift we may therefore expect to find many interesting remains of mammals. — G. C. Broadhead (*Read before the St. Louis Academy of Science, Nov.* 15, 1869).

SUDDEN DRYING UP OF STREAMS IN NEVADA. — In my article on the "Truckee and Humboldt Valleys," I casually call attention to the intermittent character of the mountain streams in that region. I state that they "run freely, even boisterously, during the night and early morning, but dry up totally in the lower part of their course by noon." My offered explanation was rather a surmise than a conclusion. I had at that time seen no other. I have just observed, however, a statement of the fact and a theory to account for it. I refer to an article by Mr. Robert Brown in the January number of the "Country Gentleman," upon "The Forest Trees and Forest Life of North-west America." He says "these streams are hid in high mountains, and the sun is not of sufficient power to melt the snow which forms their volume until late in the day, when they gather force, and again decrease after sunset until they are almost dry."

This solution of the mystery is very plausible and doubtless correct as regards the streams which came under Mr. Brown's observation. It will not apply so well, however, to those of the West Humboldt Mountains, of which I wrote. At the time my attention was drawn to the subject there was no snow upon the range, even the high summit of Star Peak being perfectly bare. Had there been snow, I think the heat of the sun in August was sufficient to melt it any time in the day. I confess that my own offered explanation does not account for the great volume of water in the streams. Although the subject has no direct connection with natural history, I have ventured to call your attention to it in order, if possible, to draw out a theory which will meet the facts. — W. W. BAILEY.

QUATERNARY DEPOSITS. — During the summer of 1865, whilst digging a pit for the foundation of a bridge abutment on the Pacific Railroad, four miles north of Pleasant Hill, Missouri, after passing through soil and dark clays at the depth of twelve feet, a bed of gravel and decomposing remains of fresh-water shells was reached, from which I obtained the tooth of an extinct species of ox.

In the year 1868, whilst prosecuting some geological examinations in Moultrie County, Illinois, I found in the bank of Kaskaskia River, the skull, with part of the vertebral column of an ox (probably *Bos latifrons*). The distance across the skull between the roots of the horns measured twelve inches, and the same between the eyes. The horns were short, thick, and but slightly curved forward and upward. On the bank above there were trees growing two feet in diameter. The bones were surrounded by dark clays and debris.

Besides remains of mammalia, bones and sticks of wood have often been found in modified drift at twenty feet or more beneath the surface. In North Missouri, sticks of wood have been found at a depth of seventy-five feet, part of a grape-vine at forty feet, and in Illinois a piece of cedar has been obtained from more than a hundred feet beneath the surface. In Nevada, Missouri, a walnut log two feet thick was dug up from

a depth of sixteen feet; and four miles north, charred wood and a bivalve shell from a depth of nineteen feet.

It may not be improper here to state that boulders and many rounded pebbles of granite, sienite, greenstone, etc., with accumulations of drift sands, abound along the north line of Missouri, and are even abundant near the line of the Hannibal and St. Joseph Railroad; further south they are more rare, being scarce near the Missouri River. In Sullivan County, Missouri, I have observed a granite boulder twenty-five feet in diameter; in Monroe County, a greenstone boulder, three feet in diameter. Near the Missouri River one is rarely found more than a foot in diameter. In Osage County, Missouri, I have only found one small granite boulder, and found none in the upper river counties on the south. The Missouri River sandbars abound* in small, rounded pebbles of mostly granite, sienite, hornstone, greenstone, lignite and quartz rock, with pebbles from neighboring rocks; all the first named pebbles are borne down from far up in the mountains.

The absence of granitoid rocks in the accumulations along the Osage and its tributaries may be sufficient evidence to place the era of these deposits in a more recent period than that of the modified drift of North Missouri. They may belong to the older loess or bluff, and we may conclude the horse, ox, mammoth and mastodon to be coexistent. It is even probable that they may have roamed America during the epoch of the mound builders. — G. C. Broadhead, *St. Louis, Mo.*

New Mosasauroid Reptiles. — Professor Marsh has recently published in the "American Journal of Science," a notice of four new reptiles, belonging, or allied, to Mosasaurus, from the Greensand of New Jersey. He remarks that "a striking difference between the reptilian fauna of the Cretaceous of Europe and America is the prevalence, in the former, of remains of Ichthyosaurus and Plesiosaurus, which here appear to be entirely wanting; while the Mosasauroids, a group comparatively rare in the Old World, replace them in this country, and are abundantly represented by several genera and numerous species.

Scolithus a Sponge. — Mr. E. Billings has referred the supposed casts of worm burrows, named Scolithus and Arenicolites, and found in Silurian rocks, to the sponges. He believes that these ancient sponges, at least many of them, lived in the sand or soft ooze of the ocean's bottom, with their sometimes wide and trumpet-shaped mouths, just even with or a little elevated above the surface. — Scientific Opinion.

ANTHROPOLOGY.

Relics from the Great Mound. — I send in this letter a perforated shell disk and an oblong bead. They were found with many others in

* Granite and other igneous pebbles are found further to the south than Illinois.

removing the "big mound" in this city. The grave was seventy feet long, eighteen feet wide, and twenty-five feet below the surface; the bodies were in a sitting attitude facing the east; the bones are nearly decayed and will crumble when exposed to the air. I have a lock of long black hair which was on one of the skulls; I also obtained from the same head two copper ornaments, shaped alike, which were behind the ears and beneath which were the oblong beads, one of which is enclosed; the copper ornaments are shaped like the bowl of a large tablespoon, from the convex surface of which extends a long, sharp horn. Two large conch shells were also found which are in my possession.—T. T. Richards, *St. Louis, Mo.*

[On page 256, Vol. i, of the *Transactions of the Chicago Academy of Science*, Colonel Foster mentions the finding of the "disks," "beads," etc., in the grave on the mound, and figures one of the "disks," which on the authority of Dr. Stimpson he considers as made from the shell of *Busycon perversum*, often found in connection with the mounds. Colonel Foster also states that a quantity of small shells *Marginella apicina*, from the Gulf of Mexico were also found. The ear ornaments of copper mentioned by Mr. Richards, are probably the same as those mentioned by Colonel Foster as "two copper vessels, formed like a spoon-bowl."

We have also received a number of the disks (all with holes through the centre) from Mr. Joseph F. Tucker, of Chicago, who states that they were found as described by Mr. Richards. We would like to publish carefully made figures of the ear ornaments in the Naturalist.

Can any one inform us whether the skulls found in this grave on the "Great Mound" have been compared with those of undoubted mound skulls? For there seems to be much uncertainty relating to this mound. Was it really formed by the mound builders, or even used by them, or were the skeletons found there of the present Indian race? It will be remembered that Professor Smith, of St. Louis, who watched the leveling of the mound, was satisfied that it was a river deposit, and not an artificial mound.—F. W. P.]

The Death of Michael Sars, the distinguished Naturalist and Professor at the Royal University at Christiana, Norway, was noticed in the last number of the Naturalist. Since that notice was written we have learned with sincere regret that Professor Sars leaves a family of six children in very impoverished circumstances. In view of the fact that American zoologists are deeply indebted to Professor Sars for the light he has thrown upon many of the lower forms of animals in the unrivalled investigations embodied in his publications, we feel it a duty to solicit aid for his family. Any remittance, however small, will be welcome and acknowledged, and will be forwarded to his family through the Norwegian minister.—Editors Naturalist.

George Peabody. — We have received from Mr. Carl Meinerth, of Newburyport, the finest photograph we have yet seen of Mr. Peabody. It is done by the new form of Mezzo-tint, invented by Mr. Meinerth, and is a copy of the last portrait taken of Mr. Peabody by Mayall of London in 1869.

Correction. — A slight correction needs to be made in the article on "Shavings" in the January number. The "large openings" in the figure of the oak-section spoken of on page 566, are not sections of "spiral ducts," of which there is none in the body of such wood, but of the very different dotted ducts. The shaving figured, moreover, must have been taken from an uncommon stick of oak, not to show the great accumulation of these ducts at the inner margin of each annual zone. The figure shows them only in the second layer and a part of the third.

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THE

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THE SEA OTTERS.*

BY CAPT. C. M. SCAMMON.

THE most valuable fur-bearing animals inhabiting the waters of the north-west coast of North America are the sea otters; they are found as far south as twenty-eight degrees of north latitude, and their northern limits include the Aleutian Islands.† Although never migrating to the southern hemisphere, these peculiar amphibious animals are found around the isolated points of southern Kamtschatka and even to the western Kuriles, a chain of islands that separate the Okhotsk Sea from the north-eastern Pacific.

The length of the matured animals may average five feet including the tail, which is about ten inches; the head resembles that of the fur seal of the coast, having full, black, sharp eyes, exhibiting much intelligence. The color of the females when in season is quite black, at other periods of a dark brown. The males usually are of the same shade, although in some instances they are of a jet shining black like their mates. The fur is of a much lighter shade inside than upon the surface; and extending over all are long, black, glistening hairs, which add much to the richness and beauty of the pelage. Some individuals, about the nose and eyes,

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†The most northern limit we can rely upon is sixty degrees north.

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are of a light brown or dingy white. The ears are less than an inch in length, quite pointed, standing nearly erect, and are covered with short hair.

Its hind flippers, or feet, are long and webbed much like a seal's. Its forelegs are short; the fore paws resemble those of a cat, and are furnished with five sharp claws, each measuring half an inch in length; the hind feet, or flippers, are furnished likewise.

Occasionally the young are of a deep brown, with the ends of the longest hairs tipped with white, and about the nose and eyes of a cream color.

The mating season of the sea otter is not known, as the young are met with in all months of the year; hence it is reasonable to suppose they differ from most other species of marine mammalia in this respect.*

The hunters about Point Granville say that the males are less shy, and run more in shore during May and June, and appear to be in search of the females; while on the other hand, the latter make every effort to avoid them. The time of gestation is supposed to be eight or nine months.

The oldest and most observing hunters about Point Granville aver that the *sea otter is never seen on shore unless it is wounded.* (Nevertheless we have accounts of their coming on shore upon the Aleutian Islands, which will be spoken of hereafter.)

It is possessed of much sagacity, has great powers of scent, and is exceedingly imbued with curiosity.

Its home is nearly as much in the water as some species of whales; and as whalers have their favorite "cruising grounds, so likewise do the otter hunters have their favorite *hunting grounds*, or points where the objects of pursuit are found in greater numbers than along the general stretch of the coast. About the seaboard of Upper and Lower California, Cerros St. Gerimmo, Guadalupe, St. Nicholas and

*This remark in relation to finding the young at all seasons of the year is based upon observations made at Point Granville.

St. Miguel Islands, have been regarded as choice places to pursue them; farther northward, off Cape Blanco on the Oregon coast, and Point Granville and Gray's Harbor, along the coast of Washington Territory. At the present day considerable numbers are taken by whites and Indians about these northern grounds.

Thence to the northward and westward comes a broken coast and groups of islands where the animals were in former days hunted by the employees of the Hudson Bay Company, Russian American Company, and the natives inhabiting those broken shores.

These interesting animals are gregarious, and frequently may be seen in bands numbering from fifty up to hundreds. When in rapid movement they make alternate, undulating leaps out of the water, plunging again as do seals and porpoises. When in a state of quietude they are much of the time on their backs. They are frequently seen in this posture with the hind flippers extended as if catching the breeze to sail or drift before it. They live on clams, as well as crabs and other species of crustacea; sometimes small fish. When the otter descends and brings up any article of food, it instantly resumes its habitual attitude on the back to devour it. In sunny days, when looking, it sometimes shades its eyes with one forepaw, much in the same manner as a person does with the hand.

The females usually have but a single young one at a birth, never more than two, which are brought forth on the kelp (say the white hunters), which abounds at nearly all points known as their favorite resorting places.*

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* That the otters have their young in the water, or on the kelp, appears improbable; however, may it not be possible? We have it from pretty reliable authority that they do come on the beaches about the Aleutian Islands. Is it probable that the habits of the animals change in this respect in different latitudes?

By expressing doubts as above, no reflection is cast on the hunters with whom I have conversed; on the contrary, those men who have kindly furnished me with much valuable data, I know to be of undoubted veracity, and they seem positive that "sea otters never come on shore unless in some way disabled." This is the belief of Mr. Blodget, a very successful hunter at Point Granville. He assures me that he has searched dili-

The mothers caress and suckle their offspring seemingly with much affection, fondling them with their forepaws, reclining in their usual manner, and frequently uttering a plaintive strain, which may have given rise to the saying that "sea otters sing to quiet their young ones." But when startled they rise perpendicularly nearly half their lengths out of the water; and if their quick, sharp eyes, discover aught to cause alarm, the cubs are seized with the mouth, and instantly all will disappear under water. Both males and females are sometimes seen curled up in such shapelessness as to present no appearance of animal form; when in this position they are said to be sleeping. The perpendicular attitude is likewise often adopted during the mating season.

The sea otter is rarely seen far from land, its home being in the thick beds of kelp near the shore, or about outlaying rocky reefs.

Point Granville seems to be an exception, as there is no

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gently for their tracks along the sandy beach lying between the above-named point and Gray's Harbor, but never found the least indication of them.

Captain Williams, who has long been a successful sea otter hunter on the California coast, corroborates Mr. Blodget's statement as to sea otters coming on shore on that coast.

Coxe, in his work published in 1780, writes the following in relation to the sea otter: "Of all these furs, the skins of the sea otter are the richest and most valuable. Those animals resort in great numbers to the Aleutian and Fox Islands; they are called by the Russians '*Bosbry Morfki*, or sea beavers, and sometimes Kamtchadal beavers, on account of the resemblance of their fur to that of the common beaver. From these circumstances several authors have been led into a mistake, and have supposed that this animal is of the beaver species, whereas it is the true sea otter.

The females are called Matka, or dams; and the cubs, till five months old, *Medviedki*, or little bears, because their coat resembles that of a bear; they lose that coat after five months, and then are called *Kofchloki*.

The fur of the finest sort is thick and long, of a dark color, and fine glossy hue. *They are taken four ways;—struck with darts as they are sleeping on their backs in the sea, followed in boats and hunted down till they are tired, surprised in caverns, and taken in nets.*

Their skins fetch different prices according to their quality.

At Kamtschatka, the best sell for, per skin, from thirty to forty roubles; middle sort, twenty to thirty; worst sort, fifteen to twenty-five. At Kiachta, the old and middle-aged sea otter skins, are sold to the Chinese per skin, from eighty to one hundred; the worst sort from thirty to forty.

As these furs fetch so great a price to the Chinese, they are seldom brought into Russia for sale; and several, which have been carried to Moscow, as a tribute, were purchased for thirty roubles per skin; and sent from thence to the Chinese frontiers, where they were disposed of at a very high interest."

kelp in sight from the shore, but the *Indians* say that there is kelp in large patches about ten miles seaward, where the animals resort as a breeding place.*

About the period of the establishing of Fort Astoria, near the mouth of the Columbia, and for many years following, the sea otter hunters, along the coasts of California and Oregon, were made up from nearly all the maritime nations of Europe and America, as well as from among the different tribes of natives that dwelt near the seashore. Those of the former were hardy spirits, who preferred a wild life and adventurous pursuits, rather than civilized employment. The distance coasted in their lightly constructed boats, the stealthy search for the game, and when discovered, the sharpshooting pursuit, gave these hunting expeditions a pleasant tinge of venture; moreover, the taking of sea otters on the coasts of the Californias by foreigners, was prohibited by the Mexican government; and the hunters were aware that, if detected, the penalty would be severe; hence they ever kept a watchful eye on all vessels seen, which were carefully avoided, or cautiously approached.

An "otter canoe" is fifteen feet long, nearly five wide, and eighteen inches deep. It is sharp at both ends, with flaring sides, and but little shear. Still these boats are admirable sea-goers, and regarded as unsurpassed for landing through the surf. Its shape is peculiar; so likewise are the paddles for propelling it, which are short with very broad blades, being better adapted for use in the thick beds of kelp.

The outfit when going on a cruise is limited nearly to the barest necessities. Two men usually hunt in one boat, each taking his favorite rifle, with a supply of ammunition. A little tea, coffee, sugar, flour, or ship-bread, are provided, adding pipes and tobacco, and, as a great luxury, perhaps a keg of spirits completes their equipment.

All being in readiness, they leave the quiet waters of the

* Within the last four years I have passed frequently over this locality assigned by the *Indians* as producing thick beds of kelp, but have never found any. — C. M. S.

harbor and put to sea, following the trend of the land, but occasionally making a broad deviation to hunt about some island, miles from the main.

When an otter is seen within rifle-shot instantly the hunter fires, and if only wounded the animal dives under water but soon reappears to be repeatedly shot at till captured. Sometimes three boats will hunt together; then they take positions one on each side, but in advance of the third, and all three in the rear of where the animal is expected to be seen. It is only the practised eye of experienced men that can detect the tip of the animal's nose peering above water disguised by a leaf of kelp.

Thus they cruise in search of the game landing to pass the nights, at different places well known to them, behind some point or rock that breaks the ocean swell. The *landings* are "*made*" by watching the successive rollers as they undulate upon the beach, and when a favorable time comes the boat with dexterous management glides over the surf with safety to the shore. It is then hauled up clear of the water and turned partially over for a shelter; or a tent is pitched, a fire is made of drift wood, or if this fail, the dry stalks of the cactus, or a bunch of dead chapperel serves them; the evening meal is soon partaken of with hearty relish; then come the pipes, which are enjoyed intensely. Freed from all care these hardy men talk of past adventures and frolics, and when inclined roll themselves in their blankets for a night's invigorating sleep in the open air; awaking at day-break to the screams of sea-birds and the barking of coyotes attracted by the scent of the encampment.

The morning repast over they again embark in their cockle-shell boats, launch through the surf, gain the open sea, and paddle along shore, ever on the watch for "otter sign."

From San Francisco northward as far as Juan de Fuca Strait, the hunting is chiefly prosecuted by shooting them from the shore, the most noted grounds being between

Gray's Harbor and Point Granville, a belt of low coast lying between the parallels of 46° and 48° north latitude.

The white hunter builds his two log cabins, one near the southern limits of his *beat* and the other at its northern terminus near Point Granville. During the prevalence of southerly winter gales he takes up his quarters at the last named station, as the game is found there more frequently; but when the summer winds sweep down from the north he changes his habitation and pursues the animals about the breakers of Gray's Harbor. From early dawn, till the sun sinks below the horizon, the hunter with rifle in hand and ammunition slung across his shoulder,* walks the beach on the lookout for a shot; the instant one is seen, crack goes the rifle, but it is seldom that the animal is secured by one fire. A sea otter's head bobbing about in the restless swell is a very uncertain mark; and if instantly killed the receding tide or adverse wind might drift the animal seaward, so that even if it eventually drifts to shore it may be far out of sight from the hunter by day, or is thrown on the rocks by the surge during the night, and is picked up by some one of the strolling Indians, who "run the beach" in quest of any dead seal, or otter, that may come in their way.

It is estimated that the best shooters average at least twenty-five shots to every otter killed; and only about one-half the number shot are secured by the rightful owners. But when once in his possession, it is quickly fleeced of its valuable skin, and stretched on the wall of the cabin to dry.

It is no unusual occurrence for the hunter to pass a week travelling up and down the beach, and he may shoot sixty or more rounds, perhaps kill several, but owing to *bad luck*, not one is secured, all either drifting to sea, or to shore, possibly

*I am informed by Mr. Ford, a resident near the hunting grounds, that the hunters now use a kind of a ladder, or it might be termed two ladders joined near the upper ends by a hinge, opening at the lower ends. It is made of very light material and can be easily carried by hand; when required for use it is opened and placed on the beach and mounted by the hunter when an elevation is desired, which is considered a great advantage under some circumstances.

with the flowing night-tide; and the object so eagerly and patiently sought for is at last stealthily appropriated by some skulking savage.

Notwithstanding their propensity to purloin, the Indians of the north-west coast not only occasionally shoot the sea otter as do the whites, but in the months of July and August, when calm weather prevails, they capture them by night. A small canoe is chosen for the purpose and the implement used is a spear of native make composed of bone and steel, fitted to a long pole by a socket. Four chosen men make the crew for the canoe.

Near the close of the day a sharp watch is kept on any *band* of the animals that may have been in view from the shore and their position accurately defined before beginning the pursuit. All being in readiness, as the shade of evening approaches, they launch upon the calm sea, and three men paddle in silence toward the place where the objects of pursuits were seen, while the fourth takes his station in the bow—who is either a chief or some one distinguished in the chase—watches intently for the sleeping otters. As soon as one is descried the canoe is headed for it, and when within reach the spear is launched into the unwary creature, which, in its efforts to escape, draws the spear from the pole, but is not freed yet (as there is a small strong line connecting the spear and pole together, although permitting them to separate a few feet). It dives deep, but with great effort, as the unwieldly pole greatly retards its progress. The keen-eyed savage, however, traces its course in the blinding darkness by the phosphorescent light caused by the animal's transit through the water, and when it rises upon the surface to breathe is beat with clubs, paddles, or, perhaps another spear, and is finally despatched after repeated blows or thrusts. The conflict arouses the whole band which instantly disappear, so that it is seldom that more than one is secured.

As soon as the hunt is over the animal is brought on shore, the skin taken off and stretched to dry, and when

ready for market the lucky owner considers himself enriched to the value of ten or fifteen blankets. The flesh of the otter is eagerly devoured by the Indians as a choice article of food. The mode of capture between Point Granville and the Aleutian Islands varies with the different native tribes inhabiting that coast.

About the Aleutian Islands, the natives, dressed in their water-proof garments made from the intestines of seals, wedge themselves into their *bidarkas* (which are constructed with a light wooden frame, and covered with walrus or seal skins*), and as it were plunge through the surf that dashes high among the crags, and with almost instinctive skill reach the less turbulent ground swell that heaves in every direction.

Once clear of the rocks, however, the hunters watch intently for the otters. The first man that gets near to one darts his spear, then throws up his paddle by way of signal; all the other boats form a circle around him at some distance; the wounded animal dives deeply, but soon returns to the surface near some one of the boats forming the circle; again the hunter that is near enough hurls his spear and elevates his paddle, and again the ring is formed as before. In this wise the chase is continued till the capture is made. As soon as the animal is brought on shore the two oldest hunters examine it, and the one whose spear is found nearest its head is entitled to the prize. The number of sea otters taken annually is not definitely known, but from the most authentic information we can obtain the aggregate is two thousand six hundred; valuing the skins at fifty dollars each, amounts to the sum of one hundred and thirty thousand dollars.

Whether these most valuable fur animals have decreased in numbers within the few past years is questionable. The hunting of them on the coast of California is no longer

* These "bidarkas, or skin-boats," are from twelve to eighteen feet long, according as they may be made for one or two persons, the greatest width being about thirty inches, and depth seventeen inches. In these frail crafts the natives go from Onilaski to Sanak Islands to hunt the sea otter, a distance of one hundred and sixty miles.

profitable for more than two or three hunters, and we believe of late, some seasons have passed without any one engaging in the enterprise; notwithstanding off Point Granville, which is an old hunting ground, sixty otters were taken by only three hunters during the summer of 1868, a great annual increase over many past years.

It is said that the Russian American Company restricted the number taken yearly by the Aleutian Islanders—from whom the chief supply was obtained—in order to perpetuate the stock. Furthermore may it not be that these sagacious animals have fled from those places on the coasts of the Californias, where they were so constantly pursued, to some more isolated haunt, and now remain unmolested.

FALCONRY.

BY WILLAM WOOD, M.D.

As Falconry, before the discovery of gunpowder and fire-arms, was a favorite amusement of the kings and nobles all over Europe, and as it is even to the present day among the Turks in some parts of Asia Minor; among the Persians, the Circassians, the wandering hordes of Tartars and Turcomans, and as it forms one of the chief sports of some of the native princes of India, and is not unknown in the northern provinces of China, and among several other barbarous or half-civilized countries, it may not be uninteresting to my readers to know in what estimation it has been held. I will not in this article give any account of the manner of training falcons; suffice it to say that they were taught to fly at the game and capture it, and come at call. It required months, and sometimes years, to train them properly.

Hawking was not unknown to the Romans in the early

part of the christian era, but was first introduced into England from the north of Europe during the fourth century. In 920 the Emperor Henry was called the fowler on account of his great fondness for the sport. In the eleventh century when Canute, king of Denmark and Norway, ascended the English throne, the amusement became more and more prevalent. After the ascension of William of Normandy to the English throne, none but persons of the highest rank were allowed to keep hawks. The killing of a deer, or boar, or even a hare by a serf, was punished with the loss of the delinquent's eyes, when the killing of a man could be atoned for by paying a moderate sum. In the twelfth century this was the favorite recreation of all the kings and nobles of Europe. "It was thought sufficient for noblemen's sons to wind the horn, and to carry their hawk fair, and leave study and learning to the children of meaner people." A German writer, about the year 1485, complains that "the gentry used to take the hawks and hounds to church with them, disturbing the devotions of those religiously inclined, by the screams and yells of the birds and beasts." This diversion was in so high esteem all over Europe, that Frederic, one of the emperors of Germany, thought it not beneath him to write a treatise on hawking. In 1481, in the reign of Richard III, Juliana Berners, sister of Lord Berners, and prioress of the nunnery of Sapewell, wrote a tract on falconry, which was loudly applauded by her cotemporaries, and became what Hoyle has on games,—a standard treatise. In 1615 and 1619, two works on the same subject were published in London, the former, by Gervase Markham, the latter, by Edmund Bert.

In the thirteenth century the arbitrary law of William, then Duke of Normandy, was somewhat modified by King John, "allowing every freeman to have his eyries of hawks, falcons, etc., in his own woods." In the fourteenth century, Edward III, of England, made it felony to steal a hawk, or take the eggs, and "punished the offender by imprisonment

for one year and one day, together with a fine, at the king's pleasure." Any person finding a hawk was to carry it to the sheriff of the county, who was immediately to cause a proclamation to be made in all the principal towns in the county (each falcon had a ring put around his leg with the owner's name engraved on it, and a small bell was suspended from the neck of the bird so that it might be discovered when lost in the chase). Any attempt of the finder to conceal or appropriate it was to be punished the same as stealing. In the reign of Queen Elizabeth the imprisonment was reduced to three months, but the culprit was to lie in prison "till he got security for his good behavior for seven years."

The dignitaries of the church even indulged in the sport, and the poet Chaucer represents them as being more learned in hunting than in divinity. During the middle ages a European showed his rank by having a hawk on his fist, and when he died the bird was generally carved on his monument. Among the Welsh princes the king's falconer was the fourth officer in the state; yet he was "forbidden to take more than three drams of beer from his horn lest he should get drunk and neglect his duty." The grand falconer of France had four thousand florins per annum, was allowed three hundred hawks, and had fifty gentlemen and fifty attendants to follow him. He rode out with the King on all great occasions.

The prices paid for falcons were enormous. Sir Thomas Monson paid five thousand dollars for a pair. In Persia the gerfalcon of Russia is not allowed to be kept by any person except the king, and each bird is valued at fifteen hundred crowns. Hawks were sent as royal tokens from kings to kings, and formed a customary present from the sovereign to the embassador of a friendly power. In more ancient times they were bequeathed as valuable and honorable legacies, with the injunction, "that the legatee should behave kindly and dutifully by the said bird."

The sport suffered no decline on the accession of the Tudors. Henry VII. made laws about hawking as did also Queen Elizabeth, who occasionally indulged in the amusement with the ladies of her court. Sir Walter Raleigh, alluding to her sylvan sports, compares her and her retinue to the goddess Diana and her nymphs. John of Salisbury, who wrote in the thirteenth century, said, "that the women even excelled the men in the knowledge and practice of falconry." Henry the VIII. followed the sport until he grew so fat and unwieldy, that in attempting to vault a ditch, he fell in where the "bottom had fallen out," and would have drowned but for the assistance of a John Moody. Says Hall, "God in his goodnesse preserved hym."

In 1531, Sir Thomas Elyot "lamented that providing the numberless hawks then kept by the English gentry, with their customary food of hens, almost threatened the total extinction of the valuable race of domestic poultry." In 1536, in the twenty-seventh year of the reign of Henry VIII, owing to the inroads made upon the game, he issued a proclamation to protect them, and made it imprisonment, and such other punishment as should seem meet to his highness the King, for "any person of whatever rank who should kill, or in any way molest herons, partridges and pheasants from his palace at Westminster to St. Giles's-in-the-Fields, and from thence to Islington, Hampstead, Highgate and Hornsey Park."

Falconry had in a great measure lost its prestige in England by the beginning of the seventeenth century. Hawking was then classed among "the amusements of squires and country gentlemen generally." In a book of advice which James I. wrote for the benefit of his eldest son Henry, Prince of Wales, after recommending manly exercises, hunting, etc., he adds, "as for hawking, I condemn it not, but I must praise it more sparingly, because it neither resembleth the warres so near as hunting doeth, in making a man hardie and skilfully ridden in all grounds, and is more uncertain and

subject to mischances; and which is worst of all, is there through an extreme stirrer-up of the passions."

The greatest falconer of modern times was one of the Lord Orfords who died toward the close of the last century. This nobleman spent a princely fortune in attempting to revive an obsolete taste. He had a large number of hawks and a regular establishment of falconers. Each hawk had its separate attendant; "they were all sent on occasional voyages to the continent for the sake of a more congenial atmosphere during their time of moulting."

Having now traced falconry through the English dynasty, and as they confined it mostly to the smaller game, I will give some account of it among other nations who have carried it to a greater degree of perfection. There was no nation in Europe prior to the fifteenth century but what the emperor, kings and nobles indulged in this sport, and it was considered "as the exclusive attribute of noble blood." Even in China and Tartary in the thirteenth century, it was strictly forbidden "to every tradesman, mechanic or husbandman throughout his Majesty's dominions to keep a hawk, or any other bird used for the purpose of game, or any sporting dog." In China, Tartary, India, and some other eastern nations, they capture the stork, swan, heron and hubara with their falcons and train dogs to act in concert with them, so that they pursue and take hares, foxes, wolves, deer and antelopes.

Father Rubruquis and Marco Polo make frequent mention of the practice of hawking during the thirteenth century among the wandering Tartars. A sport which Marco was excessively fond of, and frequently indulged in. The old Venetian informs us, that the grand Khan (Kublai), who was at once Emperor of Tartary and China, kept at one place, where he was accustomed to resort for the purpose of hawking, two hundred falcons, which during his stay there "he always visited and inspected in person, at least, once a week."

The Emperor after residing the usual time in China, always proceeded to enjoy the field sports in the plains of Tartary, attended by full ten thousand falconers, who carried with them a vast number of gerfalcons, peregrine falcons and sakers. He has also with him ten thousand men who are called taskaol, distributed all over the country, whose business it is to watch the hawks, assist them when necessary, and secure the falcon when he has captured the game. Marco tells us, that the Grand Khan takes his wives and the ladies of the court with him on these expeditions, who have their own hawks and join in the sport. These with their attendants, physicians, astrologers, courtiers, slaves and falconers formed an immense retinue. Dividing up into parties of one hundred and two hundred, they proceed to the lakes and river, where they capture great numbers of storks, herons, swans, ducks and smaller game. Each bird belonging to his Majesty, or to any of his nobles, has a small silver label fastened to his leg, on which is engraved the name of the owner and the name of the keeper so that it can be readily restored. The manner of taking the prey shows great skill and sagacity, the falconer usually carries his hawk to the field on his fist protected by a glove, and on seeing game, removes the head-gear (a hood to cover the head and eyes of the bird) and casts the bird off with a loud whoop to encourage her. If the bird flushed is a duck, partridge, pheasant, or any bird that does not soar high, the hawk quickly strikes and brings it down, but if it is a heron, or some bird strong on the wing, it will attempt to keep above the hawk. Now comes the tug of war, each trying to mount above the other until nearly out of sight, when the falcon by performing a succession of spiral circles rises above the game, and darts down upon it with all her force and velocity, when both tumble from the sky together. the sportsman hastening to the spot with all possible dispatch assists the hawk in her struggle with the prey. Marco informs us that "the Emperor had reclaimed eagles which

were trained to swoop at wolves, and such was their strength that none, however large, could escape from their talons."

The accounts given by Father Rubruquis and Marco Polo would seem incredible were not their statements fully confirmed by other writers. The description given by Johnson of the number and magnificence of the hunting retinue of the Nabob-vizir of Lucknow makes it nearly, if not quite, equal to that of the Emperor of Tartary and China as described above.

The Persians, on some occasions when hunting hares and other four legged animals, dress their hawks with leather breeches. I will give the language of Sir John Malcolm respecting it. "When at Shiraz the Elchee had received a present of a very fine Shah-Baz or royal falcon. Before going out I had been amused at seeing Nutee Beg, our head-falconer, a man of great experience in his department, put upon this bird a pair of leathers which he fitted to its thighs with as much care as if he had been the tailor of a fashionable horseman. I inquired the reason of so unusual a proceeding. 'You will learn that,' said the consequential master of the hawks, 'when your see our sport;' and I was convinced at the period he predicted of the old fellow's knowledge of his business."

"The first hare seized by the falcon was very strong, and the ground rough. While the bird kept the claws of one foot fastened in the back of his prey, the other was dragged along the ground till it had an opportunity to lay hold of a tuft of grass, by which it was enabled to stop the course of the hare, whose efforts to escape I do think, would have torn the hawk asunder if it had not been provided with the leathern defences which have been mentioned."

The account given by Marco of the training of eagles for the chase is fully substantiated by a later writer, Thomas Witlam Atkinson. The following account of hunting with the eagle in Chinese Tartary is related by him in his "Seven Years Explorations and Adventures in Siberia, Mongolia, the

Kirghis Steppes, Chinese Tartary and a part of Central Asia." "A well-mounted Kirghis held the bearcoote, chained to a perch, which was secured into a socket on his saddle. The eagle had shackles and a hood and was perfectly quiet, he was under charge of two men. "We had not gone far when several large deer rushed past a jutting point of the reeds and bounded over the plain about three hundred yards from us. In an instant the bearcoote was unhooded and his shackles removed, when he sprung from his perch and soared up into the air. I watched him ascend as he wheeled round, and was under the impression that he had not seen the animals; but in this I was mistaken. He had now risen to a considerable height and seemed to poise himself for about a minute. After this he gave two or three flaps with his wing and swooped off in a straight line towards his prey. I could not perceive that his wings moved, but he went at a fearful speed. There was a shout, and away went his keeper at full gallop followed by many others. When we were about two hundred yards off the bearcoote struck his prey. The deer gave a bound forward and fell; the bearcoote had struck one talon into his neck, the other into his back, and with his beak was tearing out his liver. The Kirghis sprang from his horse, slipped the hood over the eagle's head, and the shackles upon his legs, and removed him from his prey without difficulty. The keeper mounted his horse, his assistant placed the bearcoote on his perch, and he was ready for another flight. No dogs are taken out when hunting with the eagle, they would be destroyed to a certainty; indeed, the Kirghis asserts that he will attack and kill the wolf. We had not gone far before a herd of small antelopes were seen feeding on the plains. Again the bird soared up in circles as before, and again he made the fatal swoop at his intended victim, and the animal was dead before we reached him. The bearcoote is unerring in his flight; unless the animal can escape into holes in the rocks, as the fox does sometimes, death is his certain doom." In another

place he says "next morning before starting, I sketched Sultan Beck and his family. He is feeding his bearcoote—hunting with the king of birds being his favorite sport."

The Persians have a peculiar kind that they train to fly at antelopes and to act in concert with dogs. The huntsmen proceed to a plain, or rather desert, near the seaside with hawks on their hands and greyhounds led in a leash. When an antelope is seen they endeavor to get as near as possible, but the animal the moment that it observes them goes off at a rate that seems swifter than the wind; the horsemen are instantly at full speed, having slipped the dogs. If it is a single deer they at the same time fly the hawks, but if a herd they wait till the dogs have fixed upon a particular antelope. The hawks skimming along near the ground soon reach the deer, at whose head they pounce in succession, and with so great violence as to confuse the animal so much as to stop his speed in such a degree that the dogs can come up and in an instant, men, horses, dogs and hawks surround the unfortunate deer and capture it. The antelope is supposed to be the fleetest quardruped on earth, and the rapidity of the chase is said to be wonderful and astonishing, the distance run, generally, not exceeding three or four miles.

In the spring of 1861, on the return from Russia of our late Ex-Governor, Thomas H. Seymour, who had been minister to that country for several years, in conversation with him, I learned that falconry was still a favorite sport in the East, and that he had joined in the chase several times; that eagles were trained as formerly, and that he had seen falcons with their leathern breeches on catch hares and hold them by inserting one talon into the game and holding on to the turf, or anything that came in the way with the other, and that they held on with such tenacity that their limbs would be dislocated or torn from their bodies were they not thus protected.

CERTAIN PARASITIC INSECTS.

BY A. S. PACKARD, JR.

THE subject of our discourse is not only a disagreeable but too often a painful one. Not only is the mere mention of the creature's name of which we are to speak tabooed and avoided by the refined and polite, but the creature itself has become extinct and banished from the society of the good and respectable. Indeed under such happy auspices do a large proportion of the civilized now live that their knowledge of the habits and form of the louse may be represented by a blank. Not so with some of their great-great-grandfathers and grandmothers if history, sacred and profane, poetry, and the annals of literature testify aright; for it is comparatively a recent fact in history that the louse has awakened to find himself an outcast and an alien. Among savage nations of all climes, some of which have been dignified with the apt, though high sounding name of Phthiriophagi, and among the Chinese and other semi-civilized peoples, these lords of the soil still flourish with a luxuriance and rankness of growth that never diminishes, so that we may say without exaggeration that certain mental traits and fleshly appetites induced by their consumption as an article of food may have been created, while a separate niche in our anthropological museums is reserved for the instruments of warfare, both offensive and defensive, used by their phthiriophagous hunters. Then have we not in the very centres of civilization the poor and degraded, which are most faithfully attended by these revolting satellites!

But bantering aside, there is no more engaging subject to the naturalist than that of animal parasites. Consider the great proportion of animals that gain their livelihood by stealing that of others. While a large proportion of plants are more or less parasitic, they gain thereby in

interest to the botanist, and many of them are eagerly sought as the choicest ornaments of our conservatories. Not so with their zoological confrères. All that is repulsive and uncanny is associated with them, and those who study them, though perhaps among the keenest intellects and most industrious observers, speak of them without the limits of their own circle in subdued whispers or under a protest, and their works fall under the eyes of the scantiest few. But the study of animal parasites has opened up new fields of research, all bearing most intimately on those two questions that ever incite the naturalist to the most laborious and untiring diligence—what is life and its origin? The subjects of the alternation of generations, or parthenogenesis, of embryology and biology, owe their great advance, in large degree, to the study of such animals as are parasitic, and the question whether the origin of species be due to creation by the action of secondary laws or not, will be largely met and answered by the study of the varied metamorphoses and modes of growth, the peculiar modification of organs that adapt them to their strange modes of life, and the consequent variation in specific characters so remarkably characteristic of those animals living parasitically upon others.*

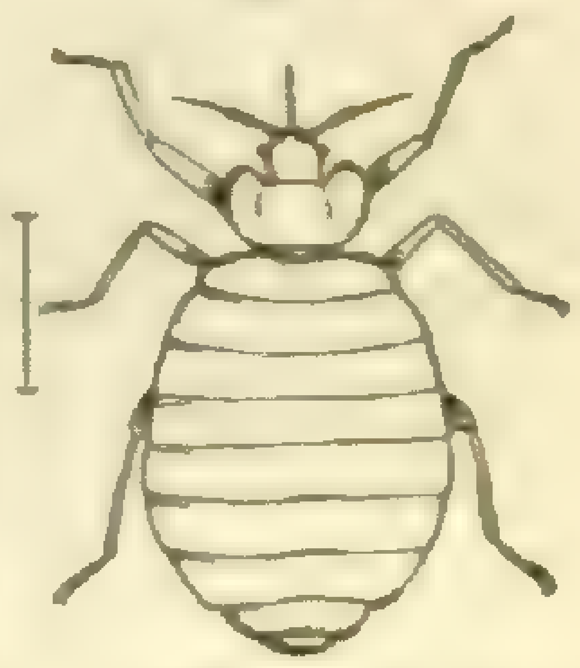
With these considerations in view surely a serious, thoughtful, and thorough study of the louse, in all its varieties and species, is neither belittling nor degrading, nor a waste of time. We venture to say, moreover, that more light will be thrown on the classification and morphology of insects by the study of the parasitic species, and other degraded, wingless forms that do not always live parasitically, especially of their embryology and changes after leaving the egg, than by years of study of the more highly developed insects alone. Among Hymenoptera the study of the minute Ichneumons, such as the Proctotrupids and Chalcids, especially the egg-parasites;

* We notice while preparing this article that a journal of Parasitology has for some-time been issued in Germany—that favored land of specialists. It is the "Zeitschrift für Parasitenkunde," edited by Dr. E. Hallier and Dr. F. A. Zürn. 8vo, Jena.

among moths the study of the wingless canker-worm moth and Orgyia; among Diptera the flea, bee-louse (*Braula*), sheep tick, bat ticks, and other wingless flies; among Coleoptera, the Meloë, and singular Stylops and Xenos; among Neuroptera the snow insect, Boreus, the Podura and Lepisma, and especially the hemipterous lice, will throw a flood of light on these prime subjects in philosophical entomology.

Without farther apology, then, and very dependent on the labor of others for our information we will say a few words on some interesting points in the natural history of lice. In the first place, how does the louse bite? It is the general opinion among physicians, supported by able entomologists, that the louse has jaws, and bites. But while the bird lice (*Mallophaga*) do have biting jaws, whence the Germans call them skin-eaters (*pelzfresser*), the mouth parts of the genus Pediculus, or true louse, resemble in their structure those of the bed-bug (Fig. 13, from the author's "Guide to the Study of Insects") and other Hemiptera. In its form the louse closely resembles the bed-bug, and the two groups of lice, the Pediculi and Mallophaga, should be considered as families of Hemiptera, though degraded and at the base of the hemipterous series. The resemblance is carried out in the form of the egg, the mode of growth of the embryo, and the metamorphosis of the insect after leaving its egg.

Fig. 13.



Bed-bug.

Schiödte, a Danish entomologist, has, it seems to us, forever settled the question as to whether the louse bites the flesh or sucks blood, and decides a point interesting to physicians, *i.e.* that the loathsome disease called phthiriasis, from which not only many living in poverty and squalor are said to have died, but also men of renown, among whom Denny in his work on the Anoplura, or lice, of Great Britain, mentions the name of "Pheretima, as recorded by Herodotus, Antiochus Epiphanes, the Dictator Sylla, the two Herods, the Emperor Maximian, and Phillip the Sec-

ond," is a nonentity. Schiödte, in his essay "On Phthirius, and on the Structure of the Mouth in Pediculus" (Annals and Magazine of Natural History, 1866, page 213), says that these statements will not bear examination, and that this disease should be placed on the "retired list," for such a malady is impossible to be produced by simply blood-sucking animals, and that they are only the disgusting attendants on other diseases. Our author thus describes the mouth parts of the louse.

"Lice are no doubt to be regarded as bugs, simplified in structure and lowered in animal life in accordance with their mode of living as parasites, small, flattened, apterous, myopic, crawling and climbing, with a conical head, moulded as it were to suit the rugosities of the surface they inhabit, provided with a soft, transversely furrowed skin, probably endowed with an acute sense of feeling, which can guide them in that twilight in which their mode of life places them. The peculiar attenuation of the head in front of the antennæ at once suggests to the practised eye the existence of a mouth adapted for suction. This mouth differs from that of Rhynchota [Hemiptera, bed-bug, etc.] generally in the circumstance that the labium is capable of being retracted into the upper part of the head, which therefore presents a little fold, which is extended when the labium is protruded. In order to strengthen this part, a flat band of chitine is placed on the under surface, just as the shoemaker puts a small piece of gutta-percha into the back of an India-rubber shoe; as, however, the chitine is not very elastic, this band is rather thinner in the middle, in order that it may bend and fold a little when the skin is not extended by the lower lip. The latter consists, as usual, of two hard lateral pieces, of which the fore ends are united by a membrane so that they form a tube, of which the interior covering is a continuation of the elastic membrane in the top of the head; inside its orifice there are a number of small hooks, which assume different positions according to the degree of protrusion; if this is at its highest point the orifice is turned inside out, like a collar, whereby the small hooks are directed backwards, so that they can serve as barbs. These are the movements which the animal executes after having first inserted the labium through a sweat-pore. When the hooks have got a firm hold, the first pair of setæ (the real mandibles transformed) are protruded; these are, towards their points, united by a membrane so as to form a closed tube, from which, again, is exserted the second pair of setæ, or maxillæ, which in the same manner are transformed into a tube ending in four small lobes placed crosswise. It follows that when the whole instrument is exserted, we perceive a long membranous flexible tube hanging down from the labium, and along the walls of this tube the setiform mandibles and maxillæ in the shape of long narrow bands of chitine. In this way the tube of

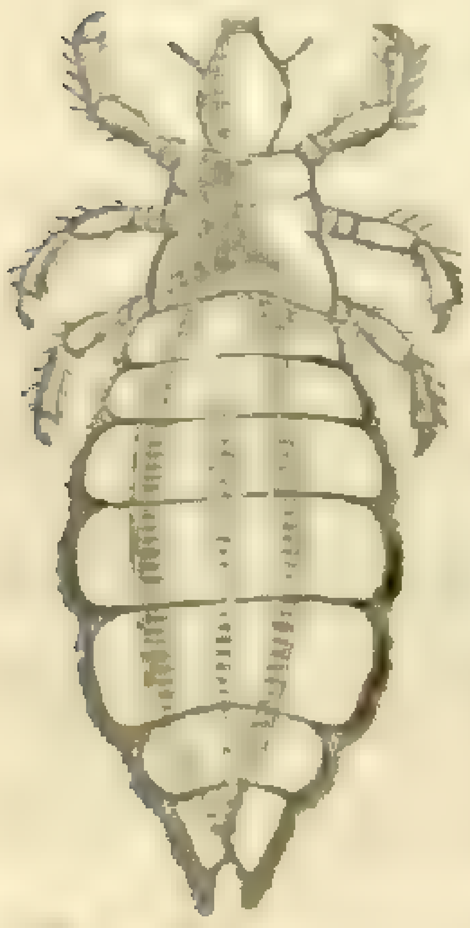
suction can be made longer or shorter as required, and easily adjusted to the thickness of the skin in the particular place where the animal is sucking, whereby access to the capillary system is secured at any part of the body. It is apparent, from the whole structure of the instrument, that it is by no means calculated on being used as a sting, but is rather to be compared to a delicate elastic probe, in the use of which the terminal lobes probably serve as feelers. As soon as the capillary system is reached, the blood will at once ascend into the narrow tube, after which the current is continued with increasing rapidity by means of the pulsation of the pumping ventricle and the powerful peristaltic movement of the digestive tube."

Fig. 14.*

Mouth of the Louse.

If we compare the form of the louse (Fig. 15, *Pediculus capitis*, the head louse; Fig. 16, *P. vestimenti*, the body louse) with the young bed-bug as figured by Westwood (Modern Classification of Insects, ii, p. 475) we shall see a very close resemblance, the head of the young Cimex being proportionally larger than in the adult, while the thorax is smaller, and the abdomen is more ovate, less rounded; moreover the body is white and partially transparent. The beak of the bed-bug we have studied from some admirable preparations made by Mr. E. Bicknell for the Museum of the Peabody Academy.

Fig. 15.



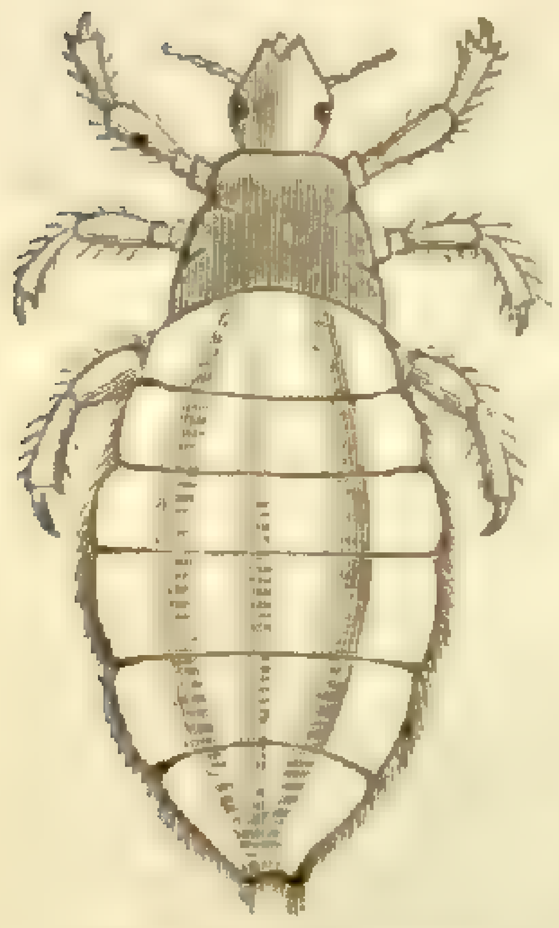
Head Louse.

Under a high power of the microscope specimens treated with diluted potash show that the man-

* Figure 14 represents the parts of the mouth in a large specimen of *Pediculus vestimenti*, entirely protruding, and seen from above, magnified one hundred and sixty times; *aa*, the summit of the head, with four bristles on each side; *bb*, the chitinous band, and *c*, the hind part of the lower lip — such as they appear through the skin by strong transmitted light; *dd*, the foremost protruding part of the lower lip (the haustellum); *ee*, the hooks turned outwards; *f*, the inner tube of suction, slightly bent and twisted; the two pairs of jaws are perceived on the outside as thin lines; a few blood globules are seen in the interior of the tube.

dibles and maxillæ arise near each other in the middle of the head opposite the eyes, their bases slightly diverging. Thence they converge to the mouth over which they meet and beyond are free, being hollow, thin bands of chitine, meeting like the maxillæ, or tongue, of butterflies to form a hollow tube for suction. The mandibles each suddenly end in a curved, slender filament, which is probably used as a tactile organ to explore the best sites in the flesh of their victim for drawing blood. On the other hand the maxillæ, which are much narrower than the mandibles, become rounded towards the end, bristle-like, and tipped with numerous exceedingly fine barbs, by which the bug anchors itself in the flesh, while the blood is pumped through the mandibles. The base of the large, tubular labium, or beak, which ensheathes the mandibles and maxillæ, is opposite the end of the clypeus or front edge of the upper side of the head, and at a distance beyond the mouth equal to the breadth of the labium itself. The labium, which is divided into three joints becomes flattened towards the tip, which is square, and ends in two thin membranous lobes, probably endowed with a slight sense of touch. On comparing these parts with those of the louse it will be seen how much alike they are, with the exception of the labium, a very variable organ in the Hemiptera. From the long sucker of the Pediculus, to the stout chitinous jaws of the Mallophaga, or bird lice, is a sudden transition, but on comparing the rest of the head and body it will be seen that the distinction only amounts to a family one, though Burmeister placed the Mallophaga in the Orthoptera on account of the mandibles being adapted for biting. It has been a common source of error to depend too much on one or a single set of organs. Insects have been classified on characters drawn from the wings, or the number of the joints of the tarsi, or the form of the mouth parts. We must take into account in

Fig. 16.



Body Louse.

endeavoring to ascertain the limits of natural groups, all the organs collectively, as well as the internal anatomy and the embryology and metamorphosis of insects, before we can hope to obtain a natural classification.

The family of bird lice is a very extensive one, embracing many genera, and several hundred species. One or more species infest the skin of all our domestic and wild mammals and birds, some birds sheltering beneath their feathers four or five species of lice. Before giving a hasty account of some of our more common species, we will give a sketch of the embryological history of the lice,* with especial reference to the structure of the mouth parts.

Fig. 17.

Embryo of the Louse.

The eggs (Fig. 17, egg of *Pediculus capitis*) are long, oval, somewhat pear-shaped, with the hinder end somewhat pointed, while the anterior end is flattened, and bears little conical micropyles (*m*, minute orifices for the passage of the spermatozoa into the egg), which vary in form in the different species and genera; the opposite end of the egg is provided with a few bristles. The female attaches her eggs to the hairs or feathers of her host.

After the egg has been fertilized by the male, the blastoderm, or primitive skin, forms, and subsequently two layers, or embryonal membranes, appear; the outer is called the amnion (Fig. 17, *am*) (though as Melnikow states, it is not homologous with the amnion of vertebrates), while the inner

* For my information on the development of the lice I am indebted to Professor Nicolaus Melnikow's "Treatise on the Embryonal Development of Insects" in Wiegmann's Archiv für Naturgeschichte, 1869, p. 136.

is called the "visceral membrane" (Fig. 17, *db*). Melnikow remarks that

"In all the insects whose embryology has been studied, and in which the ventral primitive streak is developed, neither does the amnion nor the visceral membrane take any part in building up the body of the embryo, since they are provisional structures in a peculiar sense of the word. Quite different relations exist in the lice. The origin of the embryonal membranes of the louse occurs at the time of the formation of the primitive streak. The thickened blastoderm of the end of the egg on which the hairs are situated folds in, and this fold is the beginning of the primitive streak and of the visceral membrane. The layer of this fold facing the ventral side of the egg, is transformed into the visceral membrane, while the other layer, opposite to the other side of the egg, becomes thickened and forms the primitive streak. The remaining portion of the blastoderm, with the exception of the primitive streak, which forms the forehead (in the more extended sense of the word) consists of the so-called amnion.

In contradistinction to those insects [Simulium, Chironomus, Donacia and Phryganidæ] in which a ventral primitive streak is developed, neither do the amnion nor visceral membrane form a capsule surrounding the contents of the egg. The amnion is intimately connected with the cephalic portion of the embryo as also with the visceral membrane. This latter is connected only with the abdominal part of the primitive streak, and the edges of the side, *i. e.* the continuation of the amnion. In opposition to those above-mentioned insects which have a ventral primitive streak, in the lice the visceral membrane and amnion share in building up the body of the embryo while they pass upon the dorsal side of the embryo.

It appears from these facts that the differences which we see in the embryonal membranes of insects, are in direct relation to the mode in which the primitive streak is formed. It seems, therefore, that the mode of origin of the primitive streak, or its position in relation to the yolk is concerned in the above-mentioned differences of the embryonal membranes.*

*Melnikow does not consider, as his fellow countryman, Metznikow, does, that the embryonal membranes of insects are homologous with those of vertebrates. He says, "the mode of origin in all vertebrates is the same. The formation of the visceral membrane and amnion of insects varies in different groups, with different modes of formation of the primitive streak. The embryonal membranes of vertebrates have a certain relation to the allantois, but the embryonal membranes of insects are correlated to the peculiar embryo of these animals. The reciprocal relations of the embryonal membranes; their relation to the whole egg and embryo are the same in all vertebrates; but in insects differences arise, which become noticeable in the position of the primitive streak in relation to the yolk. Finally, these embryonal membranes in all vertebrates are provisional, but in insects this is not the case. They are provisional only in those which have a ventral primitive streak." (Melnikow). We see, therefore, that immediately after the fertilization of the egg, great and radical differences exist between the eggs of vertebrates and articulates, and even between different groups of the latter. Those who in popular lectures and books make the sensational statement that

Again, looking at the louse's egg and its germ (Fig. 17) we see the amnion (*am*) surrounding the yolk mass, and the visceral membrane (*db*) within, partially wrapping the rude form of the embryo in its folds. The head (*vk*) of the embryo is now directed towards the end of the egg on which the hairs are situated; afterwards the embryo revolves on its axis and the head lies next to the opposite end of the egg. Our embryo previous to this important change of position may be compared with the embryo of the dragon fly (Figs.

Fig. 18.

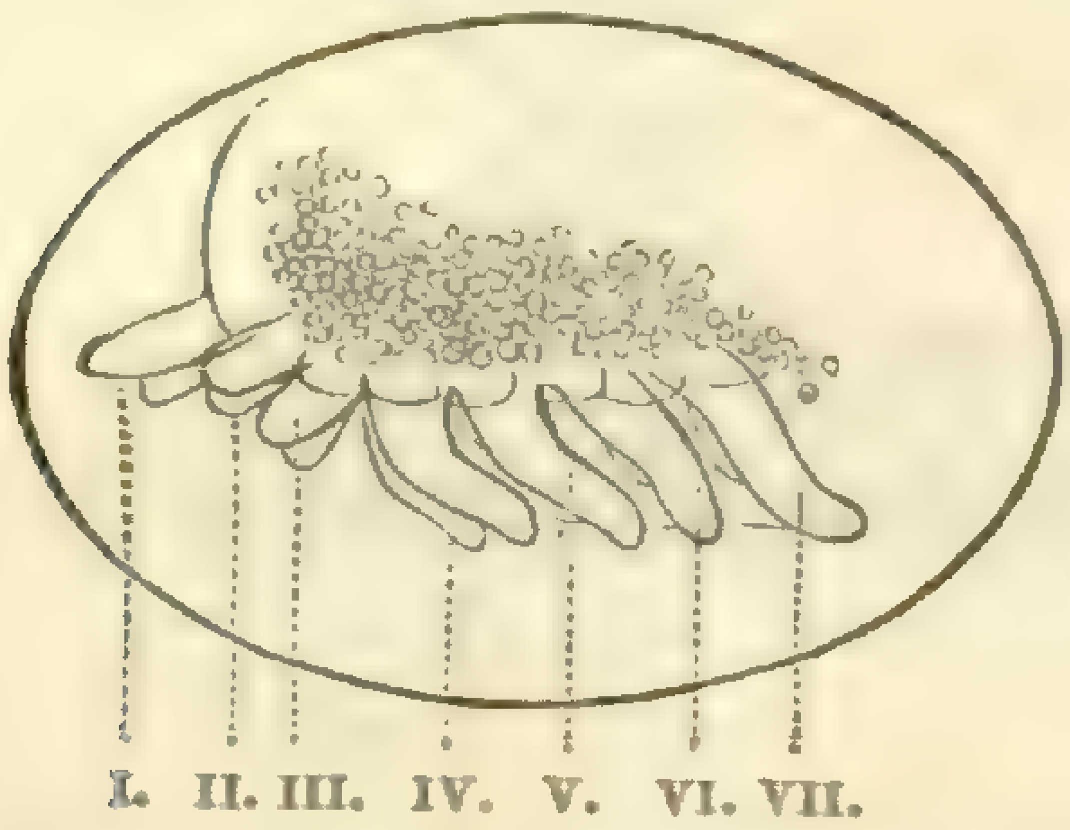
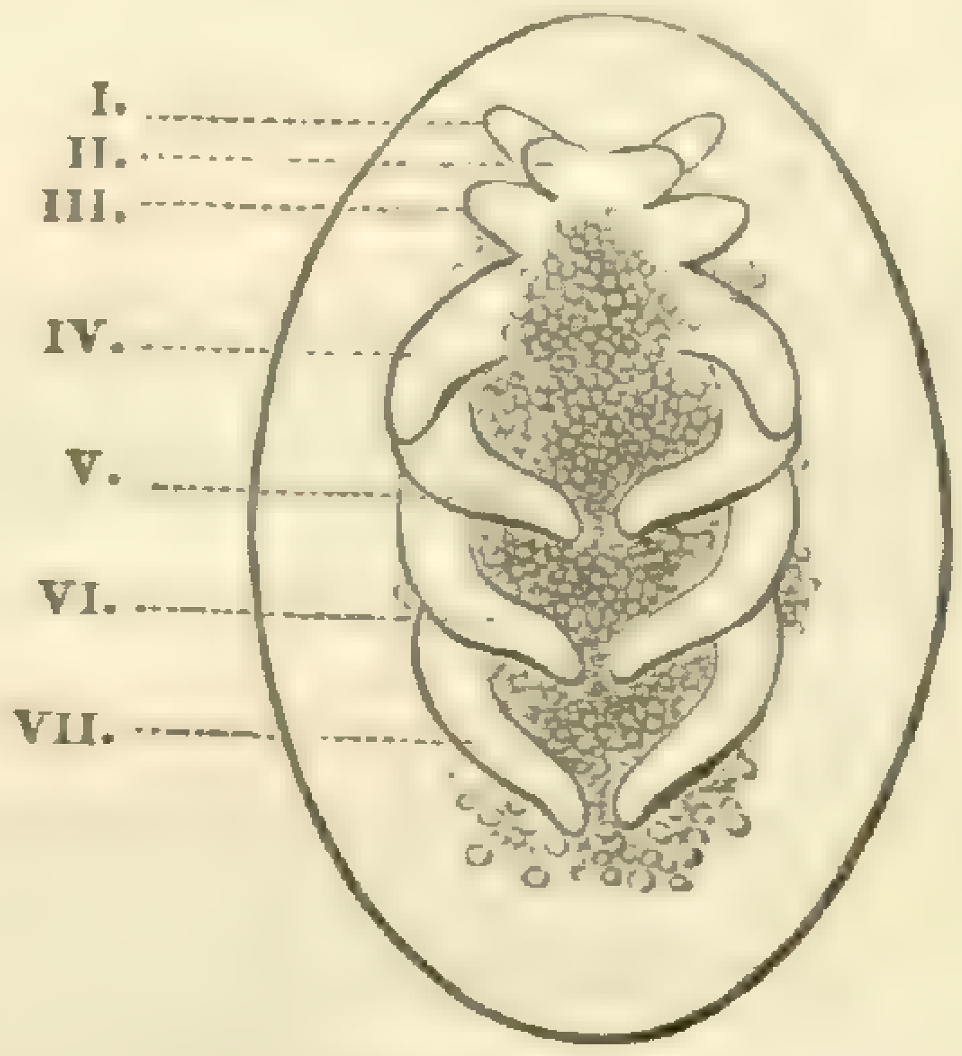


Fig. 19.



Embryo of the Dragon-fly, side view; I. antennæ; II. mandibles; III. maxillæ; IV. second maxillæ (labium); V.–VII. legs.
Fig. 19, ventral view of the same.

18, 19). Eight tubercles bud out from the under side of the head, of which the foremost and longest are the antennæ (*as*), those succeeding are the mandibles, maxillæ, and second maxillæ, or labium. Behind them arise six long, slender tubercles forming the legs, and the primitive streak rudely marks the lower wall of the thorax and abdomen, not yet formed. Figure 20 represents the head and mouth parts of the embryo of the same louse; *vk* is the forehead, or clypeus; *ant*, the antennæ; *mad*, the mandibles; *max*[1], the first pair

at first the eggs of all animals, as well as the early stages of the embryo, are alike, have not regarded the important differences presented at the first sketching out of the embryo. The great differences between the two branches of vertebrates and articulates arise before the most rudimentary form of the embryo is indicated; indeed it may be said with truth, at the first beginnings of life. Those also who indulge in glittering generalities regarding the identity in the structure of the eggs of animals, and the protoplasmic matter of which they are composed, should also take into account the radical differences of the mode of action of this protoplasm (*i. e.* egg-contents, yolk and albumen) in the eggs of vertebrates and insects at the dawn of life, whether they be due to the "vital force," or to some chemical force conserved and metamorphosed into a life-giving power.

of maxillæ and *max*^{2}, the second pair of maxillæ, or labium. At this time the embryo may be compared with that of the dragon fly of the same period of growth (Fig. 24 *c*, clypeus; 1, antennæ; 2, mandibles; 3, maxillæ; 4, labium; 5, 6, 7, legs.) We see that the mouth parts of the louse, so unlike those of other adult insects, are originally similar to them. Figure 21 represents the mouth parts of the same insect a

Fig. 20.

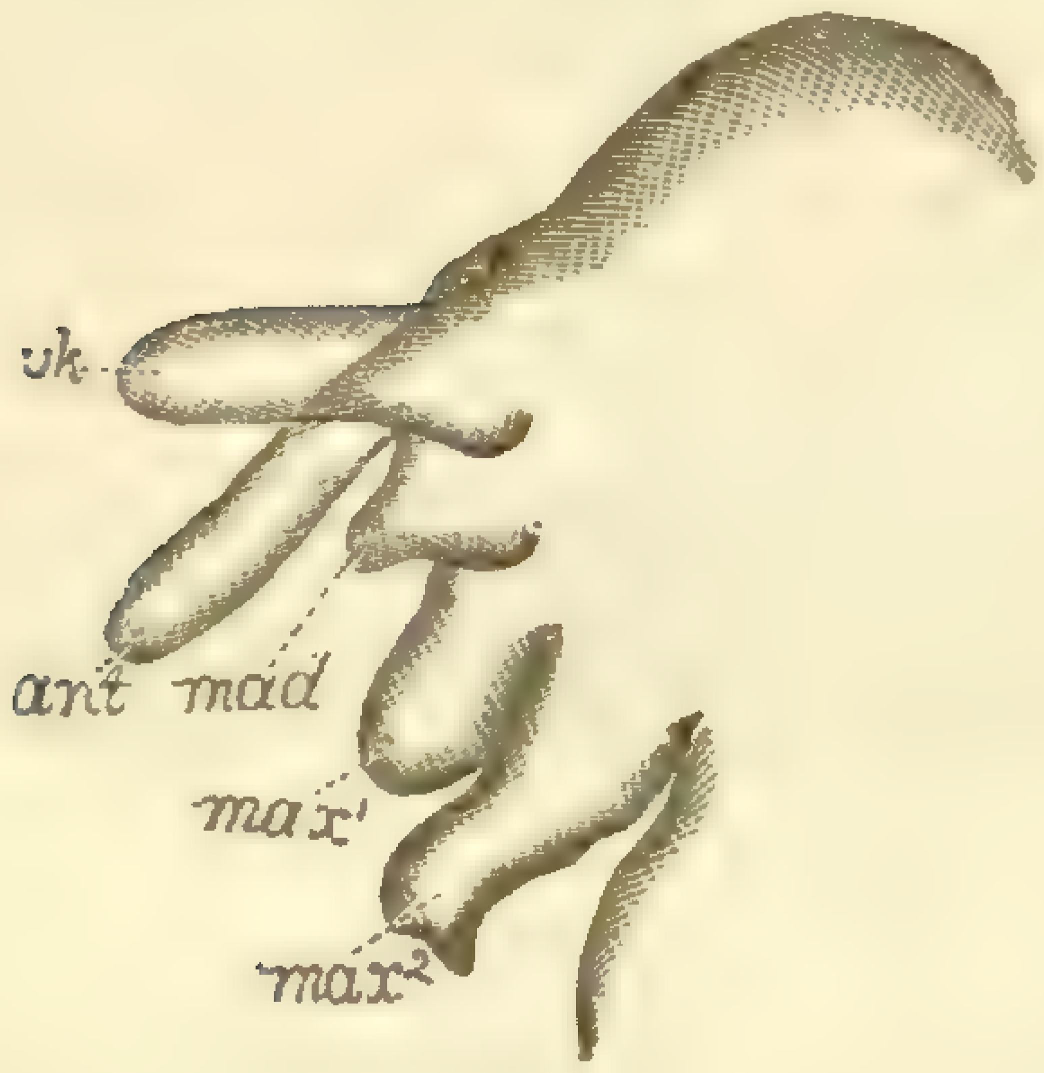


Fig. 21.

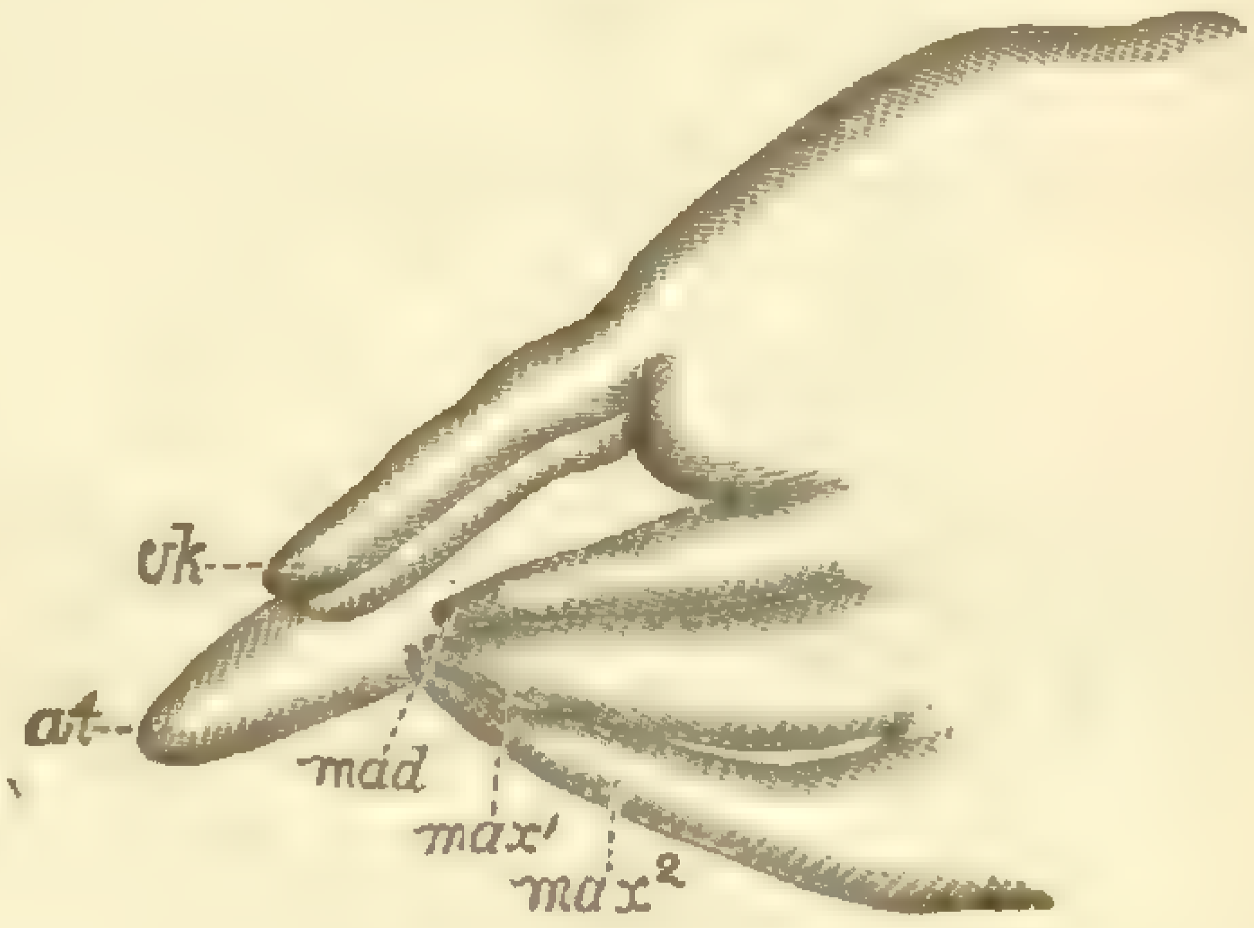


Fig. 22.

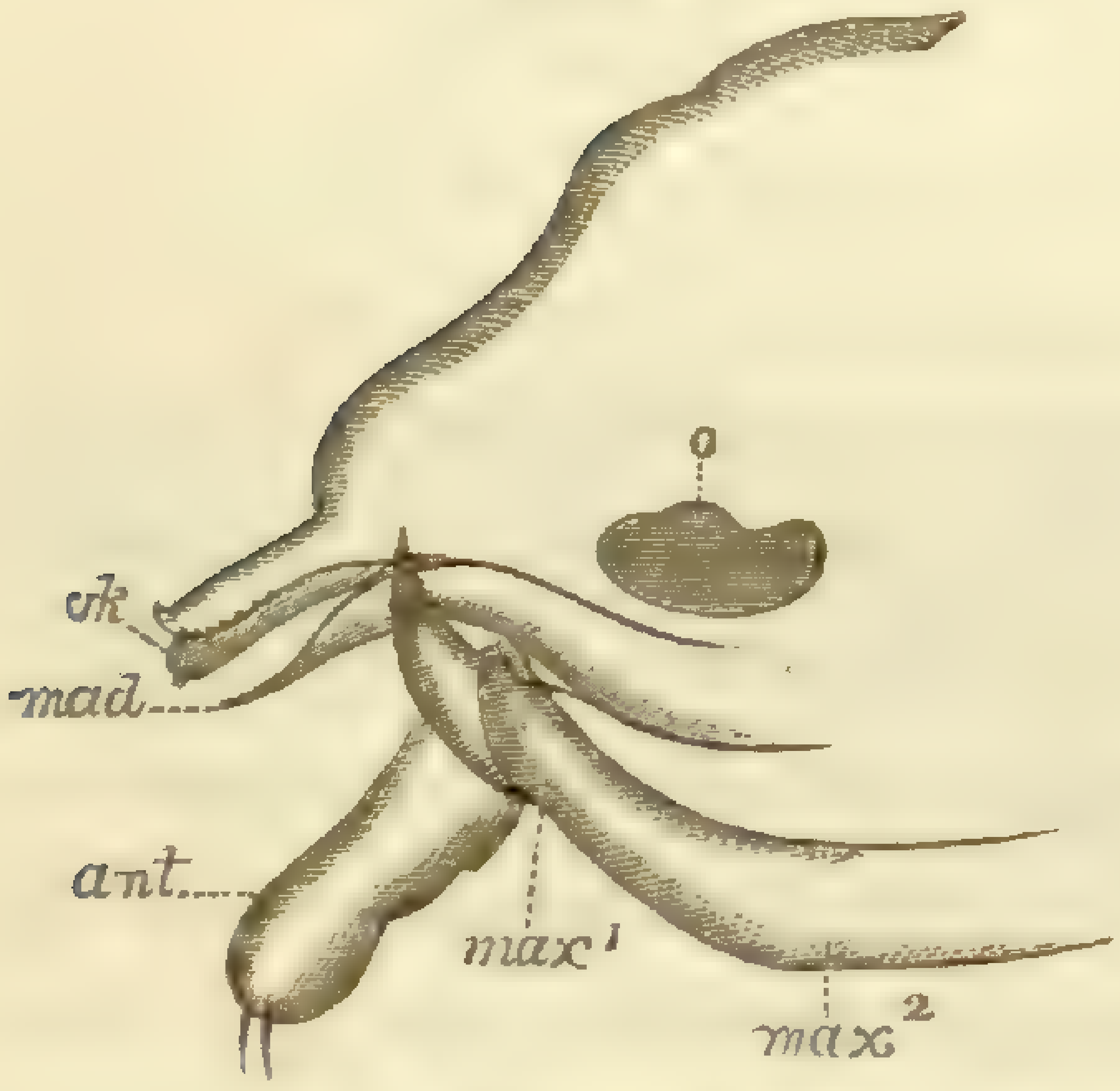
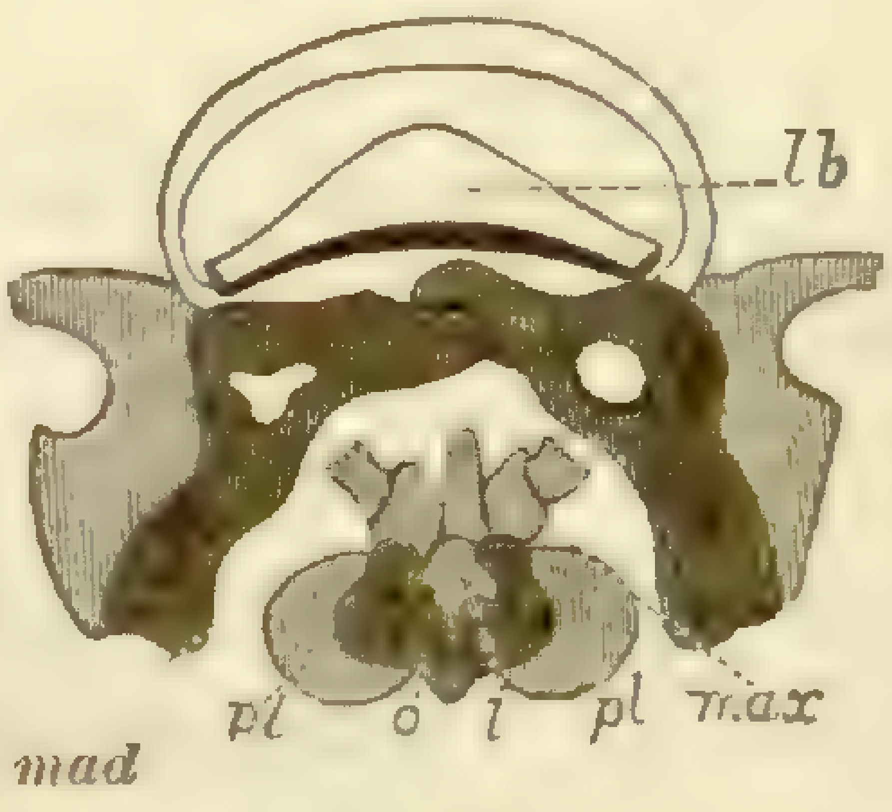


Fig. 23.



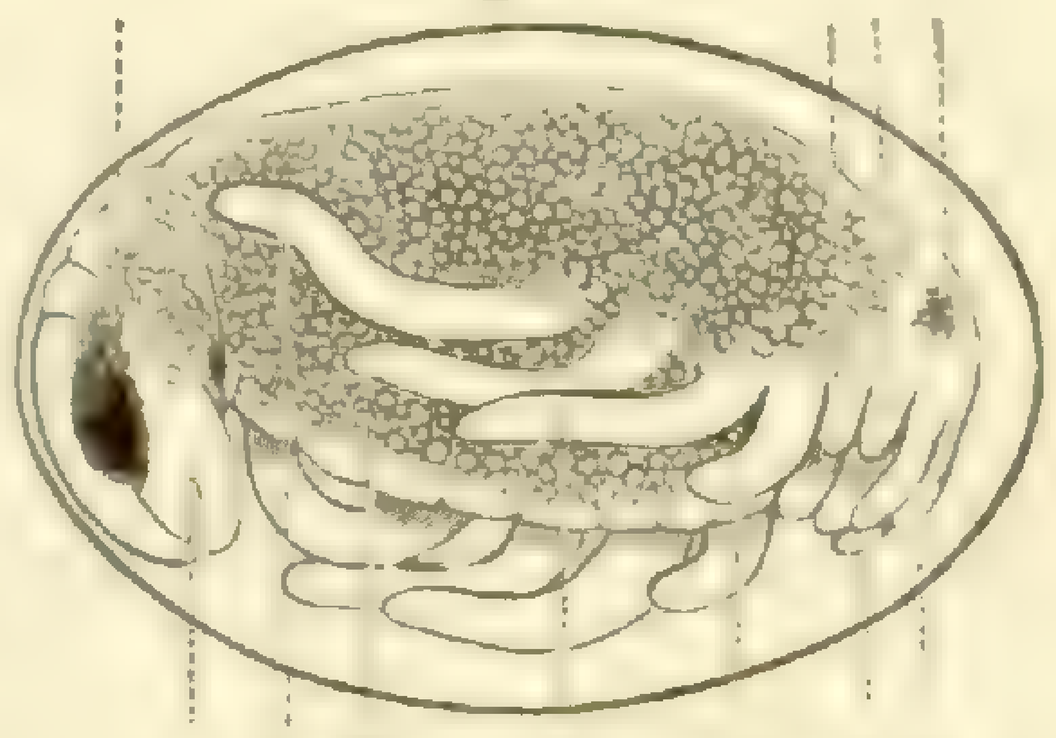
DEVELOPMENT OF THE MOUTH PARTS OF THE LOUSE.

little farther advanced, with the jaws and labium elongated and closely folded together. Figure 22 represents the same still farther advanced; the mandibles (*mad*) are sharp, and resemble the jaws of the Mallophaga; and the maxillæ (*max*^{1}) and labium (*max*^{2}) are still large, while afterwards the labium becomes nearly obsolete. Figure 23 represents the mouth parts of a bird louse, Goniodes; *lb*, is the upper

lip, or labrum, lying under the clypeus; *mad*, the mandibles; *max*, the maxillæ; *l*, the lyre-formed piece; *pl*, the "plate," and *r*, the beak or tongue. (This, and Figs. 20, 21, 22, are from Melnikow).

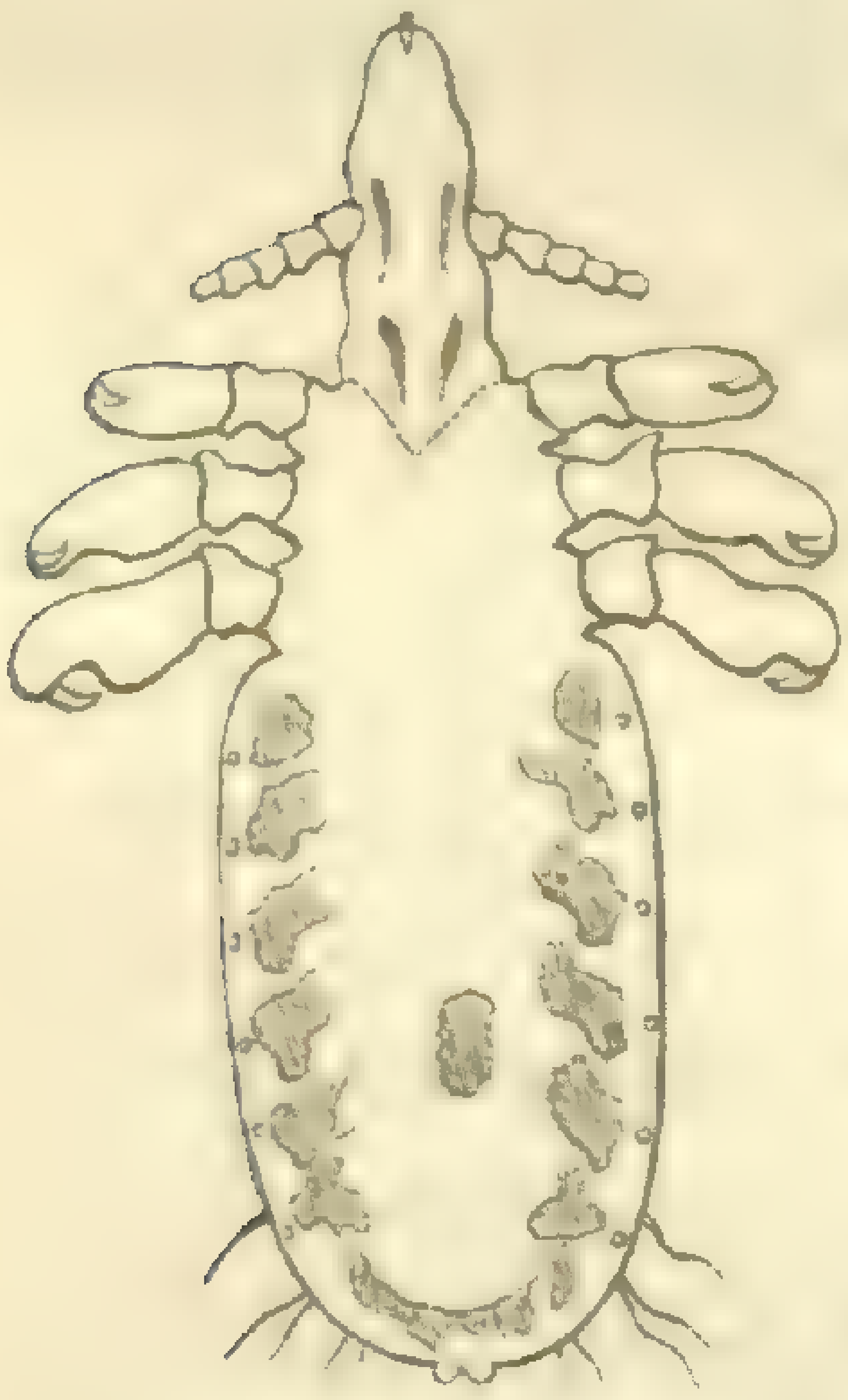
We will now describe some of the common species of lice found on a few of our domestic animals, and the mallophagous parasites occurring on certain mammals and birds. The family Pediculina, or true lice, is higher than the bird lice, their mouth parts, as well as the structure of the head, resembling the true Hemiptera, especially the bed bug. The clypeus, or front of the head, is much smaller than in the bird lice, the latter retaining the enlarged forehead of the embryo, it being in some species half as large as the rest of the head.

Fig. 24.



All of our domestic mammals and birds are plagued by one or more species of lice. Figure 25 represents the *Hæmatopinus vituli* (Linn.), which is brownish in color. As the specimen figured came from the Burnett collection of the Boston Society of Natural History, together with those of the goat louse, the louse of the common fowl, and of the cat, they are undoubtedly naturalized here; the other specimens were collected by Mr. C. Cooke, and are in the Museum of the Peabody Academy of Science.

Fig. 25.



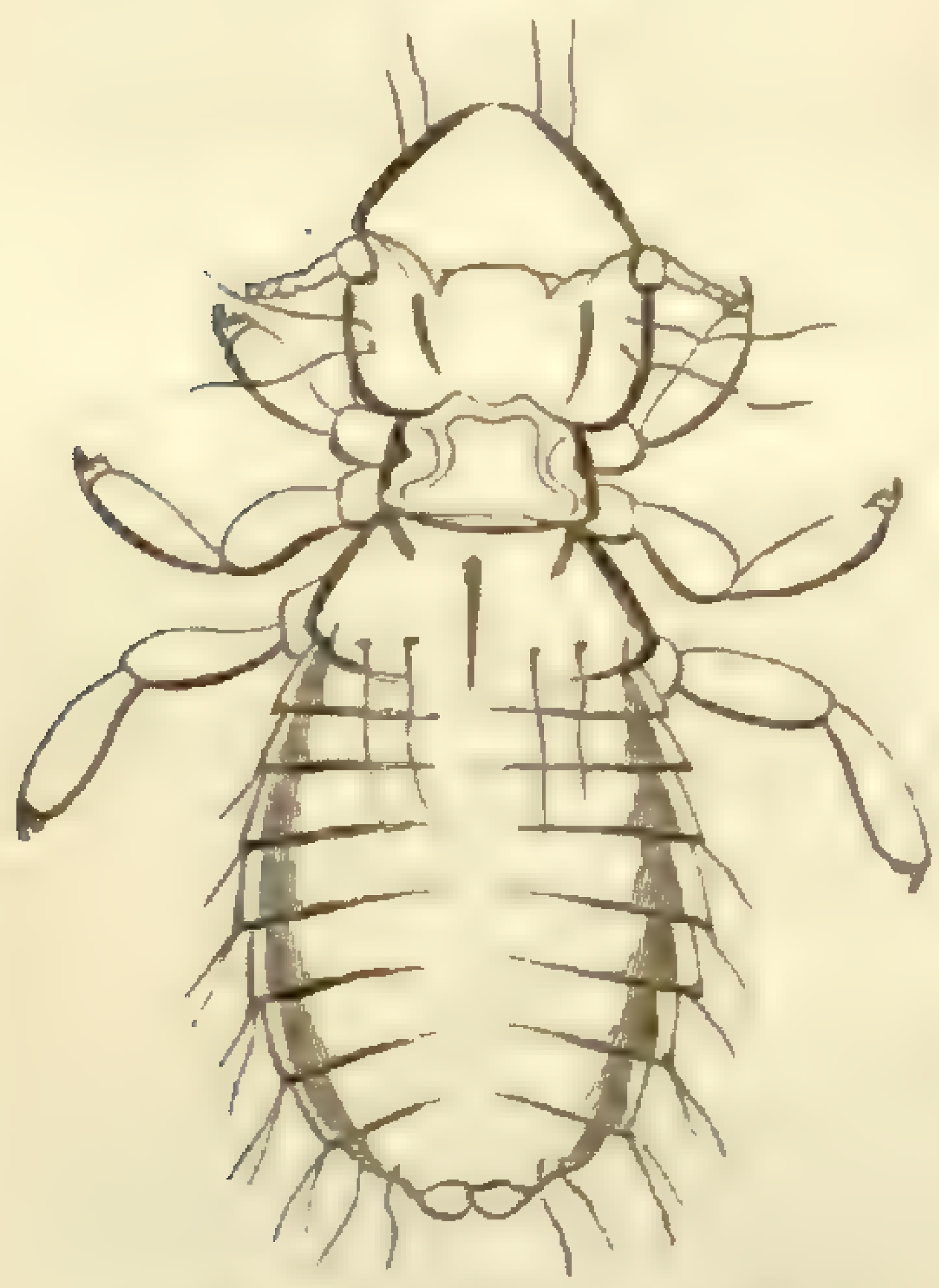
Louse of Cow.

The remaining parasites belong to the skin-biting lice, or Mallophaga, and I will speak of the several genera referred to here in their natural order, beginning with the highest one and that which is nearest allied to Pediculus. The species of Docophorus, figured on Pl. I, fig. 3, appears to be undescribed, and may be called *D. buteonis*. It lives beneath the

feathers of the Red-shouldered Hawk. It is honey-yellow, and the abdomen is whitish, with triangular chitinous plates on each segment, the two on the segment next to the last forming a continuous band. The head is longer than broad, with the trabeculæ (or movable horny process just in front of the antennæ), as long as the two basal joints of the antennæ, and extending to the middle of the second joint; the basal joint of the antennæ is rather thick, and the second joint is as long as the two terminal ones.

Another species (*Docophorus hamatus* n. sp., Pl. I, fig. 1), taken from the Snow Bunting (*Plectrophanes nivalis*) by Mr. C. A. Walker, Feb. 10, 1869, is white and has a large triangular head, with a very narrow prothorax, not much more than one-half as wide as the head; the abdomen is rounded oval, while the trabeculæ are very long and hooked.

Fig. 26.



Louse of Domestic Fowl.

An undescribed species of Nirmus (*N. thoracicus*, Pl. I, fig. 5) found on the Snow Bunting, is a large white form with the prothorax remarkably large, and but slightly narrower than the head, which is triangular. A narrow dark line extends along each side of the head and body. The trabeculæ are large, placed near the front of the head, and the antennæ in our specimens appear to be remarkably short, being only one-half as large as the trabeculæ and not reaching to the outer edge of the head. The abdomen is long, ovate.

The common barn-yard fowl is infested by a louse that we may call *Goniocotes Burnettii* (Fig. 27), in honor of the late Dr. W. I. Burnett, a young and talented naturalist and physiologist, who paid more attention than any one else in this country to the study of these parasites, and made a large collection of them, now in the museum of the Boston Society of Natural History. It differs from the *G. hologaster* of

Europe, which lives on the same bird, in the short second joint of the antennæ, which are also stouter; and in the long head, the clypeus being much longer and more acutely rounded; while the head is less hollowed out at the insertion of the antennæ. The abdomen is oval, and one-half as wide as long, with transverse, broad, irregular bands along the edges of the segments. The mandibles are short and straight, two toothed. The body is slightly yellowish, and variously streaked and banded with pitchy black.

Of three species of Lipeurus, figured on the plate, fig. 2 represents a male of the louse of a crow, *L. corvi*, a new species. Its body is unusually broad, and is white, with pitchy black lines along the side of the head and thorax, a row of small blackish oval spots along the abdomen, and a pair of narrow black bands on each thoracic ring. The head is broad and triangular, with large, curved, long trabeculæ, and a prominence just behind the antennæ. The latter are slender and simple, with the two basal joints moderately large, and of equal size and length; the three terminal ones are slenderer; the third and fifth are of nearly the same length; the fourth is shorter, and the fifth ends in a rather sharp point. The mandibles are slender, acute, and much curved. The legs are rather stout, with two very small claws, and a small thumb-like tubercle opposed to them.

Another species (*L. elongatus*, n. sp., Pl. I, fig. 4, ♀) is allied to the *L. baculus* and *squalidus* of Europe. It is white, with pitchy black patches along the sides of the abdomen, and at the base of the legs. The head is pitchy black along each side. The two basal joints of the antennæ are of the same length; the third joint is a little larger and longer than the fourth, while the fifth is a third longer than the fourth, and is barrel-shaped. The third species (*L. gracilis*, n. sp., Pl. I, fig. 6, ♂) has a longer and narrower head with the clypeus more expanded and larger, and the edge of the body is dark, but the band is not so wide as in *L. elongatus*. There are two conical trabeculæ, and the antennæ

are as long as the head is broad at the place of their insertion; the second joint is much longer than the first; the third and fourth are together as long as the second, while the fifth is a quarter longer than the fourth joint. The mandibles are narrow, acute, with two unequal fine teeth.

To the genus Trichodectes belongs the *T. subrostratus* Nitzsch? (Fig. 27) identified by Dr. Burnett as probably the same as the European species. It is a parasite of the common cat. The front of the rather square head is elongated triangularly, with the apex ending in two acute spines on the under side of the head. The antennæ are three-jointed, with the middle joint a little longer than the last. The abdomen is oval, and the animal is whitish, with the head and thorax pale honey-yellow. The other species lives on the goat; it seems to be undescribed, and may be called the *Trichodectes capræ* (Fig. 28); it is closely allied to *T. longicornis* of Europe, but the head is not hollowed so much in front and is rather broader, while the third joint of the antennæ is more slender than in that species. It is reddish yellow, while the abdomen is edged with red, and is barred transversely with reddish brown.

Fig. 27.

Louse of the Cat.

Fig. 28.

Louse of the Goat.

The Saddle-back Gull (*Larus marinus*) is infested by an undescribed species of louse which we may call *Colpocephalum lari*, Pl. I, fig. 1. It is dark brown and oval in form, with the head deeply indented in the middle; the anterior lobe, or clypeus (made too small in the figure), is twice as broad as long, with the basal half of the head a little wider than the head is long. The slender filiform antennæ are three-jointed, the last joint some-

what pointed. The third segment of the thorax is as wide as the head, and the legs are thick, the femora being broad. It is allied to *C. piceum* Denny, which in Europe lives on the Sandwich Tern.

The most degraded genus is Gyropus, of which Mr. C. Cook has found *G. ovalis* of Europe abundant on the Guinea pig. A species is also found on the porpoise; an interesting fact, as this is the only insect we know of that lives parasitically on any marine animal.

The genus Goniodes is of great interest from a morphological and developmental point of view, as the antennæ are described and figured by Denny as being "in the males cheliform (Fig. 29, *a*, male; *b*, female); the first joint being very large and thick, the third considerably smaller, recurved towards the first, and forming a claw, the fourth and fifth very small, arising from the back of the third." He farther remarks, "the males of this [*G. stylifer*, which lives on the Turkey] and all the other species of Goniodes, use the first and third joints of the antennæ with great facility, acting the part of a finger and thumb" (Denny's *Monographia Anoplurorum Britanniæ*, 1842, p. 155 and 157). The antennæ of the females are of the ordinary form. This hand-like structure, is so far as we know, without a parallel among insects, the antennæ of the Hemiptera being uniformly filiform,* and from two to nine-jointed. The design of this structure is probably to enable the male to grasp its consort and also perhaps to cling to the feathers and hairs, and thus give it a superiority over the weaker sex in its advances during courtship. Why is this advantage possessed by the males of this genus alone? The world of insects, and of animals generally abounds in such instances, though existing in other organs,

Fig. 29.

Antennæ of Goniodes.

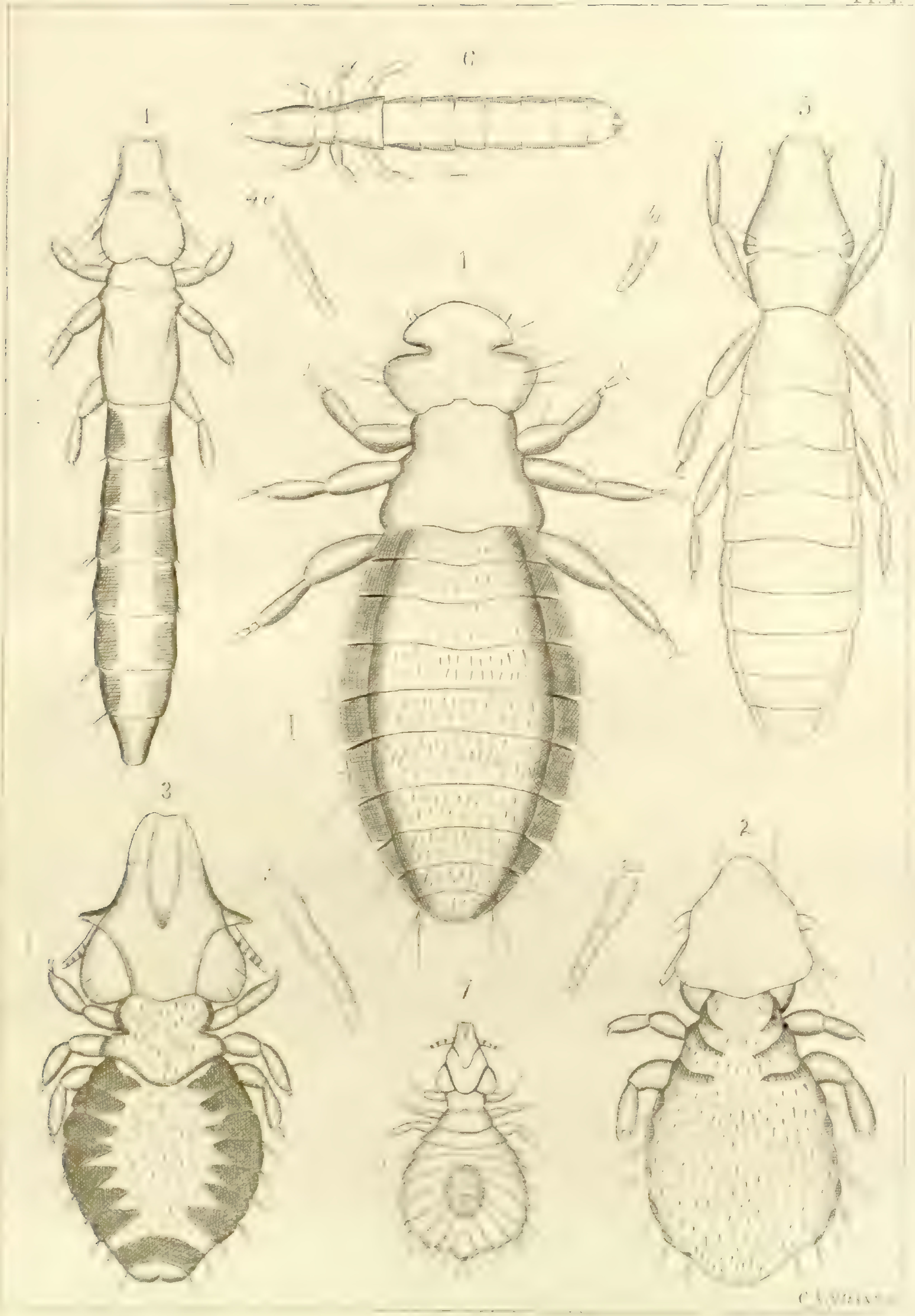
* Except in Ranatra and Belostoma where they are disposed to be flabellate, *i.e.* rudely pectinated on one side.

and the developmentist dimly perceives in such departures from a normal type of structure, the origin of new generic forms, whether due at first to a "sport" or accidental variation, or, as in this instance perhaps, to long use as prehensile organs through successive generations of lice having the antennæ slightly diverging from the typical condition, until the present form has been developed. Another generation of naturalists will perhaps unanimously agree that the Creator has thus worked through secondary laws which many of the naturalists of the present day are endeavoring, in a truly scientific and honest spirit of inquiry, to discover.

In their claw or leg-like form these male antennæ also repeat in the head, the general form of the legs, whose prehensile and grasping functions they assume. We have seen above that the appendages of the head and thorax are alike in the embryo, and the present case is an interesting example of the unity of type of the jointed appendages of insects, and articulates generally.

Another point of interest in these degraded insects is, that the process of degradation begins either late in the life of the embryo or during the changes from the larval to the adult, or winged state. An instance of the latter may be observed in the wingless female of the canker worm, so different from the winged volant male; this difference is created after the larval stage, for the caterpillars of both sexes are the same, so far as we know. So with numerous other examples among the moths. In the louse, the embryo, late in its life, resembles the embryos of other insects, even Corixa, a member of a not remotely allied family. But just before hatching the insect assumes its degraded louse physiognomy. The developmentist would say that this process of degradation points to causes acting upon the insect just before or immediately after birth, inducing the retrogression and retardation of development, and would consider it as an argument for the evolution of specific forms by causes acting on the animal while battling with its fellows in the

Pl. 1.



struggle for existence, and perhaps consider that the metamorphoses of the animal within the egg are due to a reflex action of the modes of life of the ancestors of the animal on the embryos of its descendants.

EXPLANATION OF PLATE 1.

Fig. 1. *Colpocephalum lari* Pack. 1*a*, antenna. The short line by the side gives the length of the insect.
Fig. 2. *Lipeurus corvi* Pack. 2*a*, antenna.
" 3. *Docophorus buteonis* Pack. 3*a*, antenna.
" 4. *Lipeurus elongatus* Pack. 4*a*, antenna.
" 5. *Nirmus thoracicus* Pack.
" 6. *Lipeurus gracilis* Pack.
" 7. *Docophorus hamatus* Pack.

NOTES ON FRESH-WATER FISHES OF NEW JERSEY.

BY CHARLES C. ABBOTT, M. D.

THE character of the Delaware River, in the vicinity of Trenton, New Jersey, the head of navigation, is quite varied; the bed is stony, with scattered large rocks above the rapids, and sandy, with some vegetation below the falls; the current is swift to the rapids, but less so, being tide water, below them; these conditions, with that of the varied character of the tributaries at and near Trenton, make it an excellent point at which to examine the ichthyology of this river basin. This has been done partly by those who have received collections therefrom; but there is nothing in the publications of their studies giving any knowledge of the habits of these fish, but simply the fact of their presence in these waters.

The ichthyic fauna is quite large, as some streams are cold and swift, that until lately harbored trout; and other streams, sluggish and thick, that are paradisiacal to the mudfish (*Melanura*), and the sucker (*Hylomyzon*).

In the present paper we propose not only to mention the results of the study of the habits of the species particularized, but to refer also to observations we have made, that apply to the fishes of these waters as a class, rather than to any single species. These observations we will give first, and then notice separately the more interesting species, in conclusion.

We would first call attention to *alterations in circumscribed faunæ*. These changes are what have occurred lately in the small brooks, either emptying into the river directly, or tributary to the two large creeks, the Assunpink, and Crosswicks. We give only such instances as have occurred under our own notice. In the month of June, 1867, we fished the entire length of a never failing spring-brook, remarkable always for the number of specimens, if not of species. The fauna consisted, as usual, of chubs (*Semotilus rhotheus* and *S. corporalis*) ; dace (*Argyreus atronasus*), and minnows (*Fundulus multifasciatus*). The abundance of these species was relatively as named. During the first week of July following, a heavy, sudden fall of rain caused a considerable rise in the brook, and the extra bulk of water rushing over the narrow bed, altered the character of the brook so slightly, that it attracted no notice from those accustomed to seeing it daily. On the subsidence of the water, no cyprinoids, or in fact other fish, could be found, although we left hundreds in the stream. A week later we found a few roach (*Stilbe Americana*) ; they were never seen by us previously, in this stream, and still later, young mullet (*Moxostoma oblongum*). No chub have since been seen in this brook, which during the summer past (1869), was well tenanted with the species substituted in 1867, for them. During the last summer a few red-fins (*Hypsilepis cornutus*), and shiner (*Hypsilepis Kentuckiensis*), made their appearance. In a similar instance, happening in 1868, a familiar creek, teeming with cyprinoids, but with representatives of no other family, was found after a freshet to have lost a large number

of its species, and those remaining, represented by but few individuals; while percoids, heretofore wanting, appeared in the shape of Banded Sunfish (*Bryttus chætodon*), and Spotted-finned Sunfish (*B. punctatus*); also a few specimens of the Pirate (*Aphrodederus Sayanus*) were met with.

A third instance of alteration in the fauna, with no change in the bulk of water, occurred in the Shabbaconk Creek, a creek flowing into the Assunpink, which latter is dammed at its mouth, effectually preventing fish, leaving this creek, from returning to it. In this instance, the *Aphrodederus Sayanus*, which, for several seasons previous to 1867, had been abundant, suddenly disappeared. We have searched for them repeatedly since, but never have taken a single specimen. In the Assunpink Creek, where these "pirates" it would seem must have gone to, we have also carefully searched, but its extensive basin has not yet furnished a single specimen.

Such experiences of one familiar with these waters for fifteen years, explain why it is that different visitors in a few years examination of a stream or neighborhood, will in their reports differ considerably. One's own notes may be very inconsistent, on comparing those of any year with that of the preceding or following season. Even to the smaller cyprinoids, that are, we would suppose indisposed, if able, to migrate, we have applied the terms "abundant," "rare," "numerous," "scarce," at different times. More frequently these contradictory "remarks" were jotted down with reference to the occupants of small streams, but not altogether so. It is our custom *now* to look upon the contents of any one stream as but very imperfectly showing the fauna of that neighborhood, for two water-courses similar in all respects to the eye, *may have* no species common to each, although but two or three miles distant. In concluding what we have to say under this head — of changes in faunæ — we would call attention to our experience in finding ourselves apparently or really in error. Frequently

we have failed to produce for visitors what we claimed in publications as easily obtainable; so we have been forced to the conclusion that only a series of examinations, covering three or four years, will warrant one in asserting *positively*, that this or that species is a denizen of such and such waters. An instance of this presents itself forcibly now in the fact that during the past summer a few specimens of *Pomoxis hexacanthus* were caught in the Delaware River. They were not caught here before 1869, and *may not be here* during the coming summer. Through canals a few specimens might have strayed into the Delaware, or it may be they were the pioneers of the species hereafter become resident, but the fact, as it *now* stands, goes for nothing in deciding the geographical range of that species.

Recently discovered species. Professor S. F. Baird, during the summer of 1854, discovered, in New Jersey, three fresh-water percoids, the Banded Sunfish (*Bryttus chætodon*), the Spotted Olive Sunfish (*Bryttus obesus*), and the Mud Sunfish (*Ambloplites pomotis*). Sometime later Dr. Cheston Morris discovered in the Delaware, near Philadelphia, the *Pomotis* (*Bryttus*) *punctatus*, which we now believe to be distinct from *B. obesus*. With reference to the three latter species, we have only to say that their dull coloring and general similarity to other species may have caused them to be overlooked; but we very much question if they were any way near as abundant before detected by Baird and Morris, as they now are. With the *Bryttus chætodon* the case is different. A year later than the date of Baird's discovery of this species, in Atlantic County, it appeared sparingly in Watson's Creek (Mercer County), a tributary of the Delaware. Since then it has been crowding out the old time "Sunny" (*Pomotis aureus*), although never reaching over one-third the size of that sunfish.

This fish (*B. chætodon*), considering its clear silvery and jet black markings could never have been overlooked. *Wherever* it was previously to 1855 it *then* became an addi-

tion to the fauna of Mercer County, and of New Jersey, *about the time* of its discovery by Baird we believe. Few in numbers at first, it has steadily multiplied until now it is fully as common in a few streams as the *P. aureus* is in many others.

To pass now from quiet shady waters to the rapid hill-side brooks, let us discuss the active little cyprinoid, called, by Girard, *Cyprinella analostana*, and shown by Professor Cope to be the *Hypsilepis analostanus*. This little fish, we know, was not a common species, we doubt if it was an inhabitant of our waters at all twelve years ago; and now four-fifths of the streams, besides the shallow rapid waters above the falls in the river, are literally full of them. Discovered by Kirtland in 1845, in the Ohio, did they work their way from there to here, or how became they so abundant in New Jersey, we might say, suddenly? If they were throughout the past century, say, a resident of our waters, with so few individuals of their species in existence as to escape detection or to be confounded with others, what caused their numbers so suddenly to increase, that now they are taking the place of the old-fashioned Red-fin (*Hypsilepis cornutus*)?

In the absence of any facts to the contrary we have jumped at the conclusion, that these "newer species" were *to us*, "newer creations." If created of old then some undetected alterations in our waters must be going on that some few years since gave them an impregnable advantage in the struggle for existence, and which will give other species now overlooked, ultimately, a similar advantage. Granting this why do we not come across the few specimens that are now merely preserving their kind until the favorable moment arrives for their assuming a multitudinous existence? As far as we know the "rare" species of the present have somewhere localities where they are abundant, and those with us are those that are "pioneering," and are always in direct communication with the river basin where the mass of their species dwell.

Habits of fresh-water fish. We have never met with any elaborate treatise upon this subject; and have been surprised that it should be so little referred to by those who have so carefully described the fish themselves, unless it is that the describer has not generally been the collector. "Clear water," "muddy streams," "rapid creeks," "sluggish brooks," and such phrases cover the whole ground, frequently, of the habits of the species, unless like the stickle-backs they do something so marked that it cannot well be overlooked. The introduction of aquaria has not done much to elucidate the subject, in consequence of the meagre dimensions of the tanks and carelessness to imitate nature. To what we propose to refer now, more particularly, is that the habits of the same fish *vary much in accordance with their surroundings*, and that the various species *are not as confined to certain kinds of streams as is usually supposed.*

We make these two statements after a careful résumé of our many notes, giving them as the result of eleven years study of the habits of the forty-nine species, that are found in the Delaware River or its tributaries, within five miles of Trenton, in one direction or another. Take the ten percoids as an example. We have found them in every variety of water the neighborhood produced, even to the little rivulets, where young *Pomotes* and *Brytti* hovered behind rocks, in the stiller water, but dashed *up stream* on being disturbed. Now these "sun-fish" as a class, are denizens of still water; but the exceptions are not so few, as to be put under the head of "merely accidental." In sluggish, gloomy water, we have found many a school of White-perch (*Morone Americana*), that had but to swim a thousand yards to join their fellows in the swift waters of the river and like them prey upon the cyprinoids there abundant, but scarce in the muddy, quiet creek we mentioned. Often when fishing for pout and the larger Pike (*Esox reticulatus*), we have found these schools of White-perch, occasionally having the Rock-fish (*Roccus lineatus*) associated with them.

The *Aphrodederus Sayanus*, once abundant in a clear pebbly-bedded creek, is now occasionally found in deep waters with little currents, where the banks overhang sufficiently to give them a safe retreat.

The Bill-fish (*Belone longirostris*), is not sufficiently abundant in the river, to give one good opportunities of thoroughly studying it. During the summer, or autumn, numbers of them occasionally enter the Delaware and Rariton Canal at Bordentown, New Jersey, and thence come into the canal basins. When the water is let out of the canal in December these fish are sometimes caught in the basins which are a little deeper than the canal. In these puddles, if not discovered by boys, they will remain during the winter, half buried in the mud, and semi-torpid. On the opening of navigation in March they seem to be wholly revivified, and frequent this artificial water-course during much of the summer, but finally disappear. An accident brings them, but they adapt themselves to the surroundings, as their remaining during the summer shows. Occasionally seeing quantities of young about two inches long seems to show that they spawned in the canal. The common Barred Minnows, *Fundulus multifasciatus*, have occasionally been seen by the author in spring-basins, at a considerable elevation from the brook into which its waters emptied. How they got there was a question it was found difficult to answer. To pass from the brook to the spring head it was necessary to pass up little perpendicular falls of twelve and fifteen inches. Within a short time we came across a large number in a little pool about a yard in diameter, fed by a fall of just thirteen inches, and very nearly perpendicular. With a sudden onset, we forced them from their quarters and *saw several mount the fall*. The power of this fish to swim against the current is very great, and by exercise of it only could we explain their presence at fountain heads. *The mass of these fish are found in the river and tide water creeks*, but in some numbers everywhere that it is possible for any fish to live.

Many more instances might be given showing the wide range of territory and difference in habit in different localities, which these fish have; and how unsafe it is to judge from a casual circumstance or two, what may be the peculiarities of any species.

Under the headings of certain species we propose now to call attention to peculiarities that are specific in their nature, especially breeding habits of some of the less numerous residents.

Banded Sunfish (*Bryttus chætodon*). In the "Geology of New Jersey," page 807, the author under the above heading, says "this interesting species is a lover of weedy, sluggish streams and ponds, and is never met with in tide-water." We now, at this writing, are confident, that there is no fish in New Jersey found in other water not sometimes met with in tide water. Since the above quotation was put in print we have taken this sunfish from the "bellies" of shad-nets, which were drawn in decided tide waters, the Delaware and Crosswick's Creek. The breeding habits of this species have, during the past two summers, puzzled us considerably. That they occasionally scoop out a little basin in the sand, and there deposit the ova, is undoubtedly true; but not always is this the case we judge, as during April of 1868–'69, we found them in all sorts of out-of-the-way places, the females heavy with eggs, and in some instances, a female with a male at her side, were hidden at the foot of a tussock, with scarcely enough water to cover them. Two months later the ground over which they swam was perfectly dry. Was a severe battle going on between this species and the *Pomotis aureus*, that they were forced to hide themselves to preserve their ova from destruction? We did see some "nests" like those of *P. aureus*, but they were not abundant, as we had seen them previously. The other *Bryttus* is similar in his habits to the *Pomotis*, and is not so peaceable as the *B. chætodon;* but preferring localities not favorites of other "sunfish," it does not interfere much with them. The

coloration of both *B. chætodon* and *B. obesus* is very variable. On removing them from the water the black stripes of the former, and brilliant spots of the latter, are very distinct, but they soon fade even if replaced in water. In an aquarium, when first placed in it, they are dull, yellowish brown, with no distinct bars or spots, but in a short time they resume that coloring which easily distinguishes them from other sunfish; the *chætodon* becoming silvery, the *obesus*, deep olive.

Pirate Perch (*Aphrodederus Sayanus*). In the "Geology of New Jersey," page 808, we make the following statement: "The 'pirate' makes a nest after the manner of the sunfish, and with the female guards it and afterwards the young, till they reach a size of one-third of an inch, when they are left by their parents, etc." Since the above was written (1866) we have had some opportunities of farther studying the habits of this peculiar fish. We believe that they occupy the nests made by sunfish, but do not scoop them out for themselves. Furthermore this is not the only manner of breeding, but like many other fish they seek out-of-the-way places, as deserted burrowings of the musk-rats (*Fiber zibethicus*), and here the pair will remain several days, and when the young appear they are attended by the parents, or at least an adult pair, until they are about one-third of an inch. When young the Aphrodederus is very black, with a few pale, yellowish dots. The tail is margined with white, which disappears on the fish reaching an inch or more in length. The adult fish, measuring five inches in length, has been seen frequently to swallow one of its own kind measuring an inch.

Mud Minnow (*Melanura limi*). It would be an interesting question to solve in how little water and how compact mud this fish can survive. Its gills present nothing peculiar in themselves, and certainly are not powerful enough to squeeze water out of the mud in which we have found them buried, two (and one four) inches deep. On closely

examining the bottom of any ditch one can easily detect the *Melanura* lying close upon the mud as quietly as an Etheostomoid,* but if at all disturbed they immediately dart off, and with a rapid twirl and twist of their whole body will bury themselves entirely out of sight at about an angle of forty-five degrees, tail down. We have often tried this in a shallow aquarium with mud on the bottom, and always with the same result. The movement is too rapid to be learned in detail, but they *always* bury themselves in a hole scooped out with their tail, which is the most deeply buried portion of their body.

A peculiarity of this fish worthy of note is the length of time at which it will maintain one position, especially a per-

Fig. 30.

Smelt, *Osmerus mordax.*

pendicular one, head up and tail down. In an aquarium we have had them remain so four minutes, while we held just above the water a worm or fly. On slowly lowering these until they touched the water the fish would then seize them with a rapidity of movement equal to that of the trout. We have likewise seen them leap from the water a distance greater than their length, and seize insects that were upon blades of grass overhanging the ditch. The largest specimen of *Melanura limi* ever seen by the writer measured seven inches.

Frost-fish (*Osmerus mordax*). We desire to record here

* In mentioning the number of fish in this neighborhood (Trenton, N. J.) as forty-nine, we did not include the *Etheostomoidæ*, and the few stickle-backs that come and go. Both these families as represented in the Delaware will be studied and published in a separate paper.

the fact of the presence of this fish in a few numbers during almost every month of the year. In August when the young shad are going down the river, we have seen single specimens of "smelt," or "frost-fish," as they are generally called. Occasionally also when fishing for White-perch (*Morone Americana*) we have caught them. In April there is very generally a freshet that submerges the tract of meadows bordering on the river south of Trenton. On the subsidence of this water the frost-fish are occasionally seen with a few herring in the small ditches, and are known then by juvenile anglers as the "silver pike." Hearing frequent mention of silver pike, I found this to be the fish referred to. Herring that are thus caught in ditches and cut off from the creeks do not live, but the *Osmerus* appears to thrive very well. The herring is the "Alewife" (*Alosa tyrannus*).

Gizzard Shad (*Dorosoma Cepedianum*). We gave a short notice of this species in the "Geology of New Jersey," page

Fig. 31.

Gizzard Shad, *Dorosoma Cepedianum.*

822, which we will quote and speak of more particularly. "Occasionally the 'gizzard shad' is carried by a freshet into inland streams usually having very small outlets, and thus imprisoned they thrive very well. A pond near Trenton was, in 1857, stocked with them, and is now full of specimens, some weighing five pounds apiece." Besides this pond

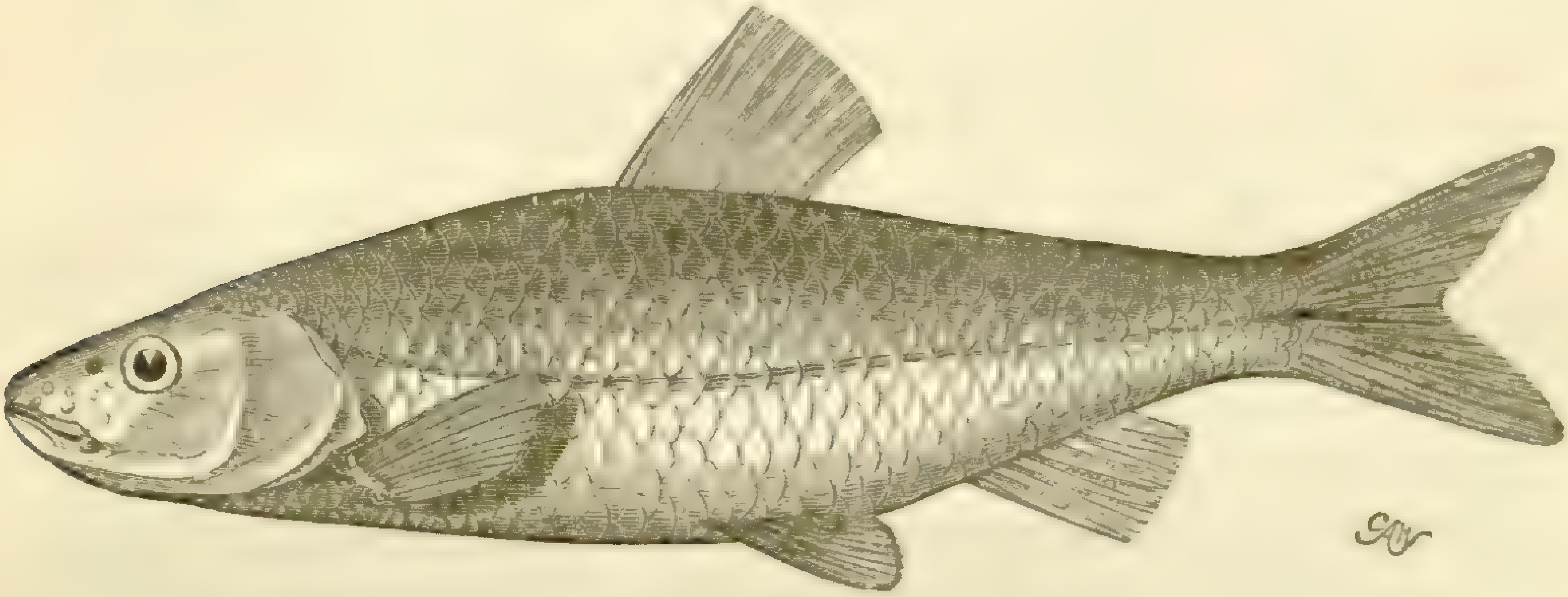
spoken of we know of one or two creeks that are annually visited by a few of these herring, and have occasionally seen *several bushels* hauled from the deep holes in the creeks they had entered. They appear in the Delaware early in March, before the other representatives of the Clupeidæ do, and as they are not ever taken in very great numbers, as are the other herring in the river, we judge that the immense quantities occasionally taken in creeks, is to be explained in the suggestion that those that come in the spring do not return. We have seen them in mid-winter frozen to death, apparently, and have reason to believe that they bury themselves in the mud when they take up their winter quarters in creeks and ponds.

The specimens we first met with, and described as *Chatoëssus insociabilis*, were from the pond referred to, stocked in 1857. They were different in coloration from the same fish as found on the coast and in the Delaware, and appeared to be distinct. If these *Dorosomæ* are left to themselves, unvisited by others later from the coast, will they in time become so far changed by the change in their surroundings as to be a different species? We thought them distinct in 1860, and the *Dorosoma*, from this same pond, is a different looking fish *now*, in 1870, from what it was *then*. The difference being one of color only it suggests the question as to whether the character of the water influences the characteristic coloring of species?

The Chub (*Semotilus rhotheus* and *S. corporalis*). In all the tributaries of the Delaware, as well as in the river itself, "chub" abound. There are several points in their history that we cannot fully understand when reading what has been published of the two species, especially "Cope's Monograph on the Cyprinidæ of Pennsylvania." This author very correctly gives the Delaware as *the locality* of the *Semotilus rhotheus*, and admits the presence of *S. corporalis*. Now in the Delaware, at Trenton, "chub" are very abundant, as we described them in 1861, which description Cope says is his *S.*

rhotheus, and we agree with him; but in addition he says the *Cyprinus atromaculatus* is the young of the *S. corporalis*. If such were the case then why are not the adult *S. corporalis* abundant in the river in proportion to the presence of the young in the smaller streams? The true *corporalis* is scarce, very scarce, yet the *atromaculatus* is abundant. This, of course, is an absurdity; but these *atromaculati* are not young *rhothei;* that fish when young is wholly different in

Fig. 32.



Chub, *Semotilus rhotheus.*

color, being wholly silvery on the sides and belly, the silver becoming roseate near the back, which is "deeply, darkly, beautifully blue."

We have endeavored for several years to collect specimens of *atromaculatus* of all sizes, and so see where and when they cease to be *atromaculatus* and become true *corporalis*. We have as yet failed to do so, and have been somewhat disposed to consider it *not the young* of any species for these reasons. It is a peculiarly brook-loving species, hovering about deep holes, and most ingenious in its mode of eluding the pursuit of collectors. They are never found (that is, have not been by us) associated with the young of true "chub" as that fish is known. Their peculiar markings render them at once distinguishable from the young of *S. rhotheus*, and the two love very different waters, the *S. atromaculatus* loving muddy bottoms, in which they

half bury themselves, while the young of *S. rhotheus* are fond of and frequent always pebbly-bottomed, rapid brooks. To recapitulate, we have, in the Delaware River and its tributaries, the *Semotilus rhotheus* in abundance, likewise the young in the directly tributary streams, equally numerous — and in certain streams, some cut off from the river by dams, the fish described by Mitchell as *Cyprinus atromaculatus*, which reaches a length of six and seven inches, and presents a coloration of black, yellow, reddish and silvery, like no other fish of our waters. If these are the young of the *Cyprinus corporalis* of the same author, why have we not this latter fish in abundance also? But we have not. Again, in streams, as the Assunpink and Shabbaconk, which are cut off from the Delaware by dams, and in the Stony-brook and Mill-stone, which are cut off from the Rariton, we have *Semotilus atromaculatus which never cease to be such.* Do they die for want of the rivers to become the *S. corporalis?* If not, where are these larger chub? In Stony-brook and the Mill-stone we have also the *S. rhotheus*, from half an inch to nearly half a yard in length. The difference in the scales of these two species of "chub" render them distinguishable without reference to color; and the *S. atromaculatus* agree with the size and number of scales of *S. corporalis*, as given in the "Monograph of the Cyprinidæ of Pennsylvania," by E. D. Cope. We are not yet satisfied, however, that the atromaculated chub of the Delaware basin is the young of any other species.

Roach (*Stilbe Americana*). Professor E. D. Cope in his Monograph says of this fish: "This Stilbe rarely exceeds seven inches in length." In the various streams in which we find the "roach," it is so frequent an occurrence to meet with them eight, nine, and nine and a half inches in length, that we are surprised at the figure mentioned by Cope as the maximum length. Otherwise his remarks accord with our observations. These large specimens have the pectoral,

ventral and anal fins brilliant orange, during the spring and early summer, and later the color is dimmed but not lost. The color of the body is, as given by him, of "a greenish, brassy, or golden lustre." Smaller specimens even during the spring have the fins black and the general coloration silvery; duller upon the back than the sides. This species is not as much annoyed by the approach of winter as are many of the cyprinoids, merely seeking deeper waters. By cutting a hole in the ice and letting down a well-baited hook they are readily taken, and the larger ones at this season are excellent eating to those who are not incommoded by the multiplicity of small bones. The largest "roach" we have ever seen measured exactly nine and seven-eighths inches.

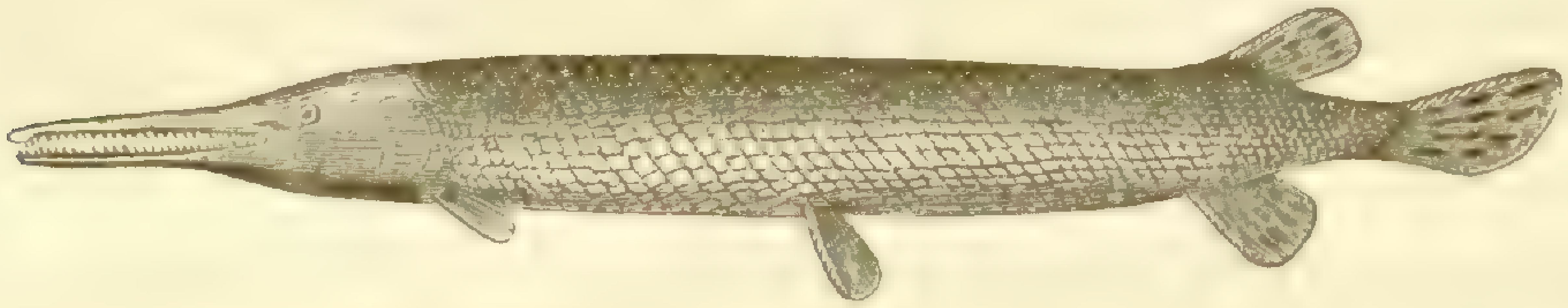
The Mud-sucker (*Hylomyzon nigricans*). In a tortuous tide-water creek, with unobstructed access to the Delaware, there are to be found at all seasons of the year where the water is deepest and the mud almost unfathomable, myriads of these "suckers"—old, young and middle-aged. Lazy, limp, almost lifeless, with a net they can be scooped up, offering no resistance, scarcely flapping their tails. As we follow up the course of this stream (Crosswick's Creek, Burlington Co., N. J.) we still find them tucked in under the overhanging banks, and so listless that on the receding of the water, at the turn of the tide, they sometimes are left high and dry before they are aware of it.* In other streams of New Jersey the fish is less abundant, and found usually with the "mullet" (*Moxostoma oblongum*). As an article of food they are good from December until April, and from then until winter are as near worthless as any fish well can be. We once saw a large specimen in the jaws of a Water-snake (*Tropidonotus sipedon*), which squealed like

* A similar instance of this is very well shown by a far different fish, the Tessellated Darter (*Boleosoma Olmstedii*), which, in the same stream, follows the waters encroaching on the meadows at high tide, and settling in little hollows about, are not aware of the recession of the water until too late. Between tides we have gathered *over one hundred* in a space not over twenty yards square. Nothing in their stomachs showed what particular article of food they sought.

a young pig, more so than cat-fish have been known to do under similar circumstances, and showing greater indications of "a voice" than does the chub, which Cope says "utters a chirruping and croaking noise."

The Gar (*Lepidosteus osseus*). During the past summer while walking on the banks of Crosswicks Creek, we were attracted by a decided commotion in the water, and on nearing the spot found a young gar, probably eighteen inches long, surrounded by and evidently harrassed by a dozen or more Bill-fish (*Belone longirostris*). It soon disappeared by sinking out of sight, but reappeared soon near the shore, giving us an opportunity of watching it. It remained as

Fig. 33.



Gar pike, *Lepidosteus osseus.*

motionless as an *Esox* for several minutes, and on the approach of a minnow would come as near the shore as possible, moving steadily backwards. If the fish came to about where the gar previously had been, it was seized in an instant, and the *Lepidosteus* would remain motionless until the approach of another Minnow would cause it to again draw back. We finally interrupted this "play" in an attempt to shoot the specimen. This fish we should judge was yearly becoming more scarce in the basin of the Delaware.

The Darters (*Etheostomoidæ*) as a class have been the most difficult to collect and study. They are with us in most streams exceedingly abundant, as also in the river itself. Lying motionless upon the flat stones or compact sand they readily escape detection, except by experts. As yet we have not made as elaborate a collection as we desire, but are satisfied we can show in this family some instances of wide geographical range, and one or more undescribed species.

Another family, the stickle-backs (*Gasterostei*), is one of much interest as found with us, but they are so uncertain in their stay in any stream that we have concluded to wait until another season's out-door work shall have given us farther opportunities to study them. The four-spined Stickle-back (*Apeltes quadracus*) as an instance, for several summers was quite abundant in several streams, and is now not seen in any of them. In Watson's Creek, in 1865, they were very abundant, and the writer found several nests ; in later seasons they were still present but in fewer numbers, and during the summers of 1868–'69 they had disappeared. We were accustomed to collect them from the "bellies" of nets drawn in the river, and lately have been very unsuccessful in finding them.

During the present, almost completed winter, the Delaware River has not been closed by ice, and judging from appearances at the time of writing (Feb. 18, 1870), it is not likely to be so closed. The fishermen have been steadily engaged in their pursuit, and with draw and gill nets have captured in very unusual abundance the commoner resident species, and also single specimens of rare fish, rare either for the time of year, or for the locality. Some of these instances are sufficiently of interest to warrant recording them.

On the 20th of January, the weather warm and water wholly free from ice, a Shad (*Alosa præstabilis*), weighing four and one-half pounds, was taken a short distance from the city. It was supposed to have been a sickly fish that had not "gone out" in August of the preceding summer. Such was proved not to be the case however, by an examination of the contents of the stomach, which demonstrated that it had come directly from salt water. Among the mass of marine food was a partially digested Killi-fish (*Hydrargyra flavula*). The Shad was a female, with ova apparently as fully matured as in May. Two or three specimens of other representatives of the Herring tribe were captured

about this time, but to what genus they belonged, the writer could not determine from what he heard. He did not see the specimens. The Gizzard Shad (*Dorosoma Cepedianum*), has been met with by single specimens and pairs, while fishing for "suckers" (*Catostomus*) and "chub" (*Semotilus*). The date is much earlier than any previous one, and probably more specimens have been taken. They were usually large, but were thin, sickly and sluggish in their movements. Probably but few of this species enter the river, or at least, come up as far as Trenton. When once they have wandered into deep ponds they will remain and breed. One pond, that has been stocked with them since 1833, contains now larger specimens than the writer has ever elsewhere seen.

On the 23d or 24th of January a healthy, strong, active Cod-fish (*Morrhua Americana*), weighing nearly four pounds, was taken in a draw-net. The stomach of this fish showed it had been in river-water for several days. The fisherman who took this specimen considered it the first instance of the kind on record, but such is not the case. Several have been taken about Philadelphia during the past twenty years. A unique occurrence, however, we believe to be the capture of a large Sturgeon in January. The Sturgeon is sensitive to the cold, but it would seem that the water had not been greatly chilled, considering the presence of this fish, which was fully as active as the species is during the summer months.

Of the resident fish that are to be taken in variable quantities during the winter, when the ice is not abundant, the sucker tribe and the Delaware chub are the principal. During the past few days the abundance of these fish has been remarkable, and in one day several bushels were taken. The number of chubs was very large and afforded excellent opportunities of examining their distinctive characters. They were all the *Semotilus rhotheus* Cope. None measured less than eight inches in length, and *every specimen, male and female, had the brilliant rosy and blue tints mentioned*

by the writer in describing this species in 1861. Mr. Cope has stated, in his Monograph on the Cyprinidæ of Pennsylvania (Transactions American Philosophical Society), that the coloration given by the writer, was that of the male in spring. The description he alludes to was drawn up in the summer. Mr. Cope is correct as to the coloration being that of the breeding season, but the tints do not grow less distinct after spawning, and *the female is very nearly, if not quite, as highly colored during February, March and April.* Later, the female becomes silvery, but the male, *in clear waters*, retains his high coloring. In muddy, sluggish waters, the bright, rosy hue becomes a reddish brown; the blue tints become leaden. Of the smaller specimens none exhibited the peculiar cloudy markings of the *Cyprinus atromaculatus* Mitchell. The largest specimen, a female, measured fourteen inches in length, and exceeded all the others in the magnificence of its coloring. The examination of nearly three hundred specimens indicated clearly that the beauty of this species was in proportion to the size, and that the sex could not be determined by the color of the specimen.

Among this enormous quantity of specimens not a single *Semotilus corporalis* was found.

NOTE.—Early in the month of February of this year, the writer received a number of "frost-fish" or "smelt," from the Raritan River, N. J. Among these fish (*Osmerus mordax*) was a single specimen of a cyprinoid, which was new to the waters of New Jersey, and was considered at the time as undescribed. The specimen was submitted to Professor E. D. Cope, and has since been described by him in MSS., as *Hybognathus osmerinus* Cope. The paper containing the description will be issued soon in the "Transactions of the American Philosophical Society of Philadelphia."

This is the only species of this genus found in the state, and is, we believe, the third genuine species of *Hybognathus* of Girard, who has described many species as belonging to this genus, which have been found since not to be true *Hybognathi*. This makes the total number of *Cyprinidæ*, belonging to the fauna of New Jersey, fourteen.

In our report of the Zoology of New Jersey, we mentioned but three species of "suckers," as found in the state. We omitted the large-scaled sucker, *Teretribus macrolepidotus*, which is very abundant in the Delaware River, about and south of Philadelphia, but it does not occur in numbers much north of the city named.

REVIEWS.

VOLCANOES AND EARTHQUAKES.* — Professor Hunt has said more in the ten pages of this little pamphlet than would suffice to fill an ordinary volume. After a description of volcanoes, volcanic products and the various zones, or regions of the earth in which volcanoes are found most abundantly, the author sums up the different theories which have been advanced in the endeavors to account for these phenomena. He rejects entirely, and with crushing force, the theory which attempts to account for volcanoes by supposing that they are the vents of a liquid nucleus, and gives a summary of his reasons for doing so from which we quote the following paragraphs:

"Judging from the known properties of the rocks with which we are acquainted, solidification should commence not at the surface, but at the centre of the liquid globe, a process which would moreover be favored by the influence of pressure. This augments the melting temperature of matters, which, like the rocks and most other solids, become less dense when melted, while on the other hand it reduces the melting point of those which, like ice [or bismuth], become more dense by fusion. Pressure, moreover, it may be mentioned in this connection, increases the solvent power of water for most bodies, whose solution may be described as a kind of melting down with water into a compound whose density is greater than that of the mean of its constituents; the importance of this point will appear farther on. The theory deduced from the above considerations, and adopted by Hopkins and by Scrope, is briefly as follows: the earth's centre is solid, though still retaining nearly the high temperature at which it became solid. At an advanced stage in the solidifying process the remaining envelope of fused matter became viscid, so that the descent from the surface of the heavier particles, cooled by radiation, was prevented, and a crust formed, through which cooling has since gone on very slowly. There were thus left between this crust and the solid nucleus, portions of yet unsolidified matter (or even perhaps, as suggested by Scrope, a continuous sheet), and it is in the existence of this stratum, or of lakes of uncongealed matter, that we are to find an explanation of all the phenomena of volcanoes and earthquakes, of elevation and subsidence, and of the movements which result in the formation of mountain chains, as ingeniously set forth by Mr. Shaler. The slow contraction of the gradually cooling globe, a most important agency in the latter phenomena, is evidently not excluded by this hypothesis. It may be added that a similar structure of the globe, viz., a solid nucleus and a solid crust separated from each other by a liquid stratum, was long ago suggested by Halley in order to explain the phenomena of terrestrial magnetism. Scrope has completed this hypothesis by the suggestion that variations in tension or pressure may cause portions of matter beneath the surface to pass from solid to liquid, or from a liquid to a solid state, and in this way helps us to explain the local and the temporary nature of volcanic activity.

This theory of Hopkins and Scrope apparently so complete in itself, is an approximation to the one which I adopt, though differing from it in some most important particulars. While admitting with them the existence of a solid nucleus and a solid crust, with an interposed stratum of semi-liquid matter, I consider this last to be, not a portion of the yet unsolidified igneous matter, but a layer of material which was once solid, but is now rendered liquid by the intervention of water under the influence of heat and pressure. When, in the process of refrigeration, the globe had reached the point imagined by Hopkins, where a solid crust was formed over the shallow molten layer which covered the solid nucleus, the farther cooling and contraction of this crust would result in irregular movements, breaking it up, and causing the extravasation of the yet liquid portions confined beneath. When at length the reduction of temperature permitted the precipitation of water from the dense primeval atmosphere, the whole cooling and disintegrating mass of broken-up crust, and poured out igneous rock would

* Abstract of a Lecture by Professor T. Sterry Hunt, LL. D., F. R. S., delivered before the American Geographical and Statistical Society, April 22, 1869. Pamph., pp. 10.

become exposed to the action of air and water. In this way the solid nucleus of igneous rock became surrounded with a deep layer of disintegrated and water-impregnated material, the ruins of its former envelope, and the chaotic mass from which, under the influence of heat from below and of air and water from above, the world of geologic and of human history was to be evolved.

It must be borne in mind that water under pressure and at high temperatures, develops extraordinary solvent powers; while from what has already been said of the influence of pressure in favoring solution, it will be seen that the weight of the overlying mass becomes an efficient cause of the liquefaction of the lower portions of the sedimentary material. Time is wanting to discuss the great forces which from early geologic periods have been active in transferring sediments, alternately wasting and building up continents. By the depression of the yielding crust beneath regions of great accumulation there follows a softening of the lower and of the more fusible strata, while the great mass of more silicious rocks becomes cemented into comparative rigidity, and finally, as the result of the earth's contraction, rises a hardened and corrugated mass, from whose irregular erosion results a mountainous region.

Those strata, which from their composition yield under these conditions the most liquid products, are, it is conceived, the source of all plutonic and volcanic rocks. Accompanied by water, and by difficultly coercible gases, they are either extravasated among the fissures which form in the overlying strata, or find their way to the surface. The variations in the composition of lavas and their accompanying gases in different regions, and even from the same vent at different times, are strong confirmations of the truth of this view, to which may be added the fact that all the various types of lava are represented among aqueous sedimentary rocks, which are capable of yielding these lavas by the process of fusion."

GEOLOGY OF COLORADO AND NEW MEXICO.* — With the small appropriation of ten thousand dollars, Dr. Hayden appears to have traversed in one season a very large territory, made extensive collections and a series of valuable and minute observations upon the geological structure of the country. The report of these is accompanied by a report upon "The Mines and Minerals of Colorado," by Professor Frazer, which gives a fair and candid statement of the mineral wealth of Colorado and New Mexico; and by a report upon the Agricultural Resources of Colorado.

These various reports cannot fail of attaining the object for which they were written, since in them every one interested in the future development of these territories may find reliable and unprejudiced information with regard to their natural resources. The sum of money appropriated for this purpose was so small that Dr. Hayden could not have accomplished a large portion of his explorations without their assistance. The appropriation of ten thousand dollars, by the central government, to explore two territories, while a state is spending annually more than twice that amount, per annum, upon a single institution, might excite some surprise and confusion in the minds of a foreigner.

The route lay along the eastern foot of the Rocky Mountains, from Cheyenne, in Wyoming Territory, to Santa Fè, the Middle Park having been explored by a lateral excursion from Denver City. Returning from Sante Fè they returned to Denver by passing up the Rio Grande and crossing the Rocky Mountains through the South Park. The explorer's remarks with regard to the superficial deposits are very interesting, and their general importance as an explanation of the origin of some of the most interesting localities is our justification for the following extract:

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* Preliminary Field Report of the U. S. Geological Survey of Colorado and New Mexico. By Dr. F. V. Hayden. Washington, D. C. 8vo. 1869.

"With the commencement of the tertiary was ushered in the dawn of the great lake period of the West. The evidence seems to point to the conclusion that from the dawn of the tertiary period, even up to the commencement of the present, there was a continuous series of fresh-water lakes all over the continent west of the Mississippi River. Assuming the position that all the physical changes were slow, progressive, and long-continued, and that the earlier sediments of the tertiary were marine, then brackish, then purely fresh water, we have through them a portion of the consecutive history of the growth of the western continent, step by step, up to the present time. The earliest of these great lakes marked the commencement of the tertiary period, and seems to have covered a very large portion of the American continent west of the Mississippi, from the Arctic Sea to the Isthmus of Darien.

About the middle of the tertiary period the second extensive lake commenced in the West, which we have called the White River tertiary basin. We believe that it commenced its growth near the south-eastern base of the Black Hills, and gradually enlarged its borders. I am inclined to think that this lake has continued on, almost or quite up to the commencement of the present period; that the light colored arenaceous and marly deposits in the Park of the Upper Arkansas, in the Middle Park, among the mountains at the source of the Missouri River, in Texas and California, and Utah, are all later portions of this great lake. The upper miocene or pliocene deposits in the Wind River Valley, near Fort Bridger, and on the divide between the Platte and the Arkansas Rivers, were undoubtedly synchronous, though perhaps not connected with this great basin. Every year, as the limits of my explorations are extended in any direction, I find evidences of what appear to be separate lake basins, covering greater or less areas, and bearing intrinsic proof, more or less conclusive of the time of their existence. I have given in this place the above brief description of the various geological formations as I have studied them in the West, in order that my subsequent remarks on these formations in their southern extension may be more clearly understood. Constant reference will be made to rocks as they have been seen in the far North and West, in order that the story of their geological extension may be linked together."

Dr. Hayden also speaks of having met with vast quantities of true drift material which he regards as originating from the neighboring mountains. "The superficial deposits at the very margins of the mountains is composed of very coarse materials, sometimes immense quantities of all kinds, but slightly worn; but proceeding from the base of the mountains, the rocks become smaller and more rounded, until they pass into small pebbles, mingled with loose sand. The phenomena of erosion, as seen at the present time, all along the flanks of the mountains, in the plains, in the channels of streams, point clearly to a vastly greater quantity and force of water than exist anywhere at the present time." A page is devoted to an account of the general structure of the mountains which Dr. Hayden's long familiarity with them enables him to condense into so brief a space:

"It is now well known that the great Rocky Mountain system is not composed of a single range, but a vast series of ranges, covering a width of six hundred to one thousand miles. There are also two kinds of ranges, one with a granitoid nucleus, with long lines of fracture, and in the aggregate possessing a specific trend; the other has a basaltic nucleus, and is composed of a series of volcanic cones or outbursts of igneous rocks, in many cases forming those saw-like ridges or sierras, as the Sierra Nevada, Sierra Madre, etc. Along the eastern portion of the Rocky Mountains, from the north line to New Mexico, the ranges with a granitoid nucleus prevail. Each one of the main ranges is sometimes split up into a number of fragments, which locally may vary somewhat from a definite direction, but the aggregate trend will be about north-west and south-east.

As I have before stated, each one of the main ranges seems to me to form a gigantic anticlinal with a principal axis of elevation, and the lower parallel ranges descending like steps to the plains, or to the synclinal valley. If, for example, we were to study carefully one of the minor mountain ranges, as the Black Hills of Dakota, or the Laramie range, where the system is very complete and regular, we should find a central granitic axis, and on each side a series of granitic ridges parallel with it, and in the aggregate trending nearly north and south. And

on the eastern portion of the anticlinal, the east side of the minor ridges slopes gently down, while the west side is abrupt; and on the western portion *vice versa*. But if we take the ridges singly and examine them, we shall find in most cases that the aggregate trend is nearly north-west and south-east. The consequence is, that as we pass along under the eastern flanks of the mountain from north to south, these minor ranges or ridges present a sort of "*en echelon*" appearance; that is, they run out one after the other in the prairies, preserving the nearly north and south course of the entire system. Not unfrequently a group or several of these ridges will run out at the same time, forming a huge notch in the main range. This notch in most cases forms a vast depression with a great number of side depressions or rifts in the mountains, which give birth to a water system of greater or less extent. Such, for example, is the notch at Cache a la Poudre, Colorado City, Canon City, on the Arkansas River, and other localities. If we were to examine the excellent topographical maps issued by the War Department, which are beyond comparison the most correct and most scientific of our Rocky Mountain region in existence, we should at once note the tendency of all the minor ranges, with a continued line of fracture and a granitic nucleus, to a south-east and north-west trend; sometimes it is nearly north and south, and then these ranges pass out or come to an end without producing any marked influence on the topography, except, perhaps, some little stream will flow down into the plain through the monoclinal rift. But when several of these minor ranges come to an end together, an abrupt jog of several miles towards the west is caused. Then frequently as the range dies out, a local anticlinal or a semi-quaquaversal dip is given to the sedimentary beds. Between the notches or breaks in the mountains, the belt of ridges or "hog-backs" becomes very narrow, sometimes even hardly visible, and sometimes entirely concealed by superficial deposits. But at these breaks the series of ridges split up and spread out so as to cover an area from half a mile to ten or fifteen miles in width. It is in these localities that the complete geological structure of the country can be studied in detail. I do not know of any portion of the West where there is so much variety displayed in the geology as within a space of ten miles square around Colorado City. Nearly all the elements of geological study revealed in the Rocky Mountains are shown on a unique scale in this locality."

In studying the mines of Colorado the explorer noticed that the lodes are almost invariably parallel, running north-east to south-west. This and the two cleavage planes, one north-east to south-west, and the other north-west to south-east, which he found to be peculiar to all the Azoic rocks, leads to an important and highly interesting generalization:

"I am inclined to believe that the problem of the history of the Rocky Mountain ranges is closely connected with these two great sets of cleavage lines. As I have before stated, my own observations point to the conclusion that the general strike of the metamorphic ranges of mountains is north-west and south-east, and that the eruptive trend north-east and south-west. The dikes that sometimes extend long distances across the plains, in all cases trend north-east and south-west, or occasionally east and west. The purely eruptive ranges of the northern portion of the San Luis Valley seemed to be composed of a series of minor ranges "*en echelon*" with a trend north-east and south-west. But as soon as this range joins on to a range with a metamorphic or granitic nucleus, the trend changes around to north-west and south-east. Many of the ranges have a nucleus of metamorphic rocks though the central and highest portions may be composed of eruptive peaks and ridges. In this case the igneous material is thrust up in lines of the same direction as the trend. It becomes therefore evident that all the operations of the eruptive forces were an event subsequent to the elevation of the metamorphic nucleus. This is shown in hundreds of instances in Southern Colorado and New Mexico, where the eruptive material is oftentimes forced out over the metamorphic rocks, concealing them over large areas."

A Geographical Handbook of all known Ferns, is the title of the latest and of the most praiseworthy of Fern-books, now so popular in England. This neat volume is by K. M. Lyell (Mrs. Col., Lyell), and is just published by Murray; a small octavo of two hundred and twenty-five pages. It gives in order, under the principal countries, a list of all their Ferns, with range and localities, and then a full series of tables exhibiting the geographical distribution of each species through the several regions.

Recent works on the Embryology of Articulates. — Besides the very valuable paper of Melnikow on the embryology of the lice and other insects already noticed and quoted, we have to enumerate several others of great importance, and which we hope to find room to notice at greater length hereafter. Professor Claparède has published a paper, richly illustrated, on the embryology of worms, especially Spirorbis, in Siebold and Kolliker's "Journal." Melnikow writes in "Wiegmann's Archiv" "On the early stages of *Tænia cucumerina*, with a few figures. Dr. Richard Greef publishes in the same number of the "Archiv" some most interesting researches on certain remarkable forms of Arthropoda and worm-types, illustrated by four plates.

Dr. Anton Dohrn has lately published the first part of his "Researches on the Structure and Development of Arthropoda" (Insects and Crustacea) with nine excellent plates. It is extracted from Siebold and Kolliker's "Journal." He here records his observations on the embryology of Cuma and allied genera, of certain sea spiders (Pycnogonidæ), and thinks that embryology shows that these curious animals, classified by many naturalists with the Arachnida, are really Crustacea; and of Daphnia, Praniza, and Paranthura Costana.

A paper of the greatest interest to entomologists is M. Ganin's "Contribution to a Knowledge of Developmental History in Insects" in Siebold and Kolliker's "Journal." It is fully illustrated, and some of the embryoes and larvæ of certain Pteromali, Platygasters and Polynemas are of such startling interest, from their resemblance to the zoeäs of crabs and to certain low worms, that we must defer any farther notice for another number, when we can insert cuts to illustrate our review.

The Bowdoin Scientific Review.* — Two numbers have appeared of this fortnightly paper, which is conducted by Professors Brackett and Goodale of Bowdoin College. It is devoted mostly to chemistry and physiology, and the editors say in their announcement that "it was originally their design to communicate to their fellow physicians in Maine recent intelligence in physiology, and chemistry applied to therapeutics. This design has not been relinquished, but it has been somewhat modified at the suggestion of many, and the scope of the journal has been widened without trespassing upon the field now so well occupied by our American journals of natural history, physical science, and medicine. It is believed that much of the work now accomplished by many of our domestic and foreign periodicals may be made more directly available by the regular publication of a review which shall call attention to the best scientific labor wherever done. From the nature of the case, the range of the journal will approach that of "Cosmos" and "Les Mondes," but more prominence will be given to the results of English and American study." We trust that this enterprising and ably conducted journal will meet with every possible encouragement. We quote the conclusion of M. Mayer's

* A Fortnightly Review. Brunswick, Maine. 8vo, pp. 32. $2.00 a year.

discourse before the Scientific Reunion of Insbruck, on Matter, Force and the Soul:

"The French physicist, Adolphe Hirn, who, at the same time with Joule, Colding, Holtman and Hemholtz, discovered the mechanical equivalent of heat, arrived at the conclusion, which I find as beautiful as true, that there are three categories of existence; first, matter; second, force; third, the soul, or the spiritual principle. When once we have succeeded in realizing that there are not only material objects, but also forces, and forces in the definite, accurate sense of modern science, as indestructible as the substances of the chemist, we have but one step farther to take, and that perfectly natural, to recognize and admit spiritual existences. In inanimate nature we speak of atoms; in the living world we find individuals. The body of the living being, as we now know it, is not only formed of material elements, but force plays also an essential part. But neither matter nor force can think, feel and will. Man thinks. For a long time we have generally supposed that the nervous substance, and especially the brain matter, contained free phosphorus, and the imagination attributed to this *free phosphorus* an important part in intellectual operations. But new and more exact researches in organic chemistry have proved that no living organ, and of course the brain, contains free phosphorus. If, on one side, similar illusions must vanish before the data of an exact science, it is none the less true, nevertheless, that there are continually produced in the living brain, material modifications, which are, as it were, the consequences of a sort of molecular activity, and that the intellectual acts of the individual are intimately connected with this material cerebral action. But it is a great error to identify these two activities which proceed parallel to each other. An illustration will render my thought clearer. We know that there can be no telegraphic communication without a concomitant chemical action. But what the telegraph says, the contents of the despatch, could never be regarded as a function of the electro-chemical action. That is still truer for the brain and thought. The brain is only the machine, it is not thought. Intelligence, which is not a part of sensible things cannot be submitted to the investigations of the physicist and the anatomist. What is true subjectively is also true objectively. Without this harmony, eternally pre-established by God, between the subjective and objective worlds, all our thoughts would be sterile. Logic is the statics of intelligence, grammar is its mechanics, and language its dynamics. I finish in saying to you with deep conviction: an exact philosophy should and can be nothing but an introduction to the Christian religion."

NATURE.* — During the last year we expressed a very favorable opinion of "Scientific Opinion," a weekly scientific newspaper, and have now to express, after a careful reading for several months, our equally strong regard for "Nature." It is in royal 8vo form, well printed, containing excellent articles by the leading scientists of Great Britain, and much valuable weekly intelligence. Everybody who can afford to do so would do well to subscribe to it.

NATURAL HISTORY MISCELLANY.

BOTANY.

EDIBLE FUNGI. — During the last few years great attention has been paid, by botanists on the one hand and epicures on the other, to the edible qualities of certain fungi. Notwithstanding the prejudice generally entertained against this class of vegetable productions, extending in Scotland, Wales and some parts of England, even to the common mushroom,

Nature, a weekly illustrated journal of science. Royal 8vo, two columns. pp. 32. Twelve cents a number. McMillan & Co. New York, 63 Bleeker street.

there is no question that a considerable number of species, very abundant in this country, are not only wholesome, but delicious articles of diet, and are at least as easily distinguished, with a little practice, from the poisonous or suspicious species, as are berries or other wild fruits. Containing a larger portion of nitrogen than any other family of the vegetable kingdom, they furnish an abundant supply of nourishment at a period of the year when very little else is to be obtained. It is calculated that there is scarcely a parish in England where tons of wholesome food are not allowed to waste every year, to say nothing of the facilities for their artificial culture. Berkeley reckons that there are at least thirty distinct English edible fungi; Dr. Curtis has partaken of forty in North Carolina, and enumerates one hundred and eleven species in that state alone reputed to be edible. Fries, the greatest living cryptogamist, is publishing a large work on the edible and poisonous fungi of Sweden; several works of a similar character have recently been brought out in Italy; in our own country the Rev. M. J. Berkeley, Mr. Worthington G. Smith and Dr. Bull of Hereford, may be mentioned as having paid special attention to the subject. — *Quarterly Journal of Science.*

Large Trees in Australia. — On this subject the government director of the Botanic Garden at Melbourne furnishes some interesting details, as follows: — "The marvellous height of some of the Australian (and especially the Victorian) trees has become the subject of closer investigation since of late (particularly through the miner's tracks) easier access has been afforded to the back gullies of our mountain system. Some astounding data, supported by actual measurements, are now on record. The highest tree previously known was a Karri Eucalyptus (*Eucalyptus colossea*), measured by Mr. Pemberton Walcott, in one of the delightful glens of the Warren River, in Western Australia, where it rises to approximately four hundred feet high. Into the hollow trunk of this Karri, three riders, with an additional pack-horse, could enter and turn in it without dismounting. At the desire of the writer of those pages (Dr. Müller), Mr. D. Bogle measured a fallen tree of *Eucalyptus amygdalina*, in the deep recesses of Daudenong (Victoria), and obtained for it the length of four hundred and twenty feet, with proportionate width; while Mr. G. Klein took the measurement of a Eucalyptus on the Black Spur, ten miles distant from Healesville, four hundred and eighty feet high. . . . . It is not at all likely that, in these isolated inquiries, chance has led to the really highest trees, which the most secluded and the least accessible spots may still conceal. It seems, however, almost beyond dispute that the trees of Australia rival in length, though evidently not in thickness, even the renowned forest giants of California, *Sequoia Wellingtonia*, the highest of which, as far as the writer is aware, rises, in their favorite haunts at the Sierra Nevada, to about four hundred and fifty feet. . . . Thus to Victorian trees the palm must be conceded for elevation." — *Mossman's Origin of the Seasons*, p. 367. [And see more at length, "Silliman's Journal" for November, 1867, p. 422.]

TENDENCY OF FLORAL ORGANS TO EXCHANGE OFFICES. — In the November NATURALIST, p. 494, "C. J. S.," speaks of finding a little ear on the apex of a staminate spike of Indian Corn. This is something new to me; but I have several times seen staminate organs, produced on the ear.

When the rains came after the past dry summer many plants seem to have made haste to produce new organs even though out of place, rather than to go on with the development of organs formed at the natural time. This tendency gives us ears of corn on the tassel, as C. J. S. has observed, and tassels formed upon the ear and many abortive ears in a single husk, as I have observed this fall. I have noticed, also, a few heads of Timothy which, instead of producing seed, have produced a growth of little leaves, and are scarcely recognizable as Timothy-heads. — D. MILLIKIN.

MONSTROSITY IN TRILLIUM. — April 28, 1866, while botanizing at Le Roy, N. Y., I found a Trillium with two stems arising from a common rootstock, each stem bearing a flower unlike the other and neither perfect. The petals of one could hardly be distinguished from its sepals, the only perceptible difference being a minute white margin surrounding the apex of each petal. The floral envelopes in this case appear to have reverted to the form and color of the leaves much more nearly, than in the other terminal flower where the petals are oblong and pure white, having a narrow green stripe running through the centre of each. Though monstrosities among the Trilliums may not be rare, I have never seen a similar one. — C. S. OSBORNE, *Rochester, N. Y.*

NOTICES OF BOTANICAL MONSTROSITIES, such as the above, we are glad to receive from our various correspondents. But they must not be disappointed if they should not appear at once. When they have accumulated a little so as to throw interest upon each other, we will print them all, or the most interesting ones, with some remarks on their classification and bearing, as illustrated in connection with a recent work upon Vegetable Teratology, by Dr. Masters of London, published by the Ray Society. If our correspondents will send us the specimens themselves, or drawings of them, it would in many cases be advantageous. As to the monstrosity in Indian corn, the attempt to produce ears on the staminate spike is common enough; the production of male flowers on the ear is so unusual that we should be very glad to see specimens. *Chlorosis* (as it is termed) in *Trillium grandiflorum* is rather common, and we find that the plant so affected goes on year after year producing such blossoms. — EDS.

ARCTIC FLORA. — Dr. Berthold Seeman discusses in the "Journal of Botany," the question whether vegetation extends to the North Pole, supposing land exists there. He answers the question in the affirmative, maintaining that excessive cold in winter exercises but a limited influence upon a vegetation which, like the Arctic, enjoys the protection of a thick covering of snow, and is besides in a state of inactivity. The temperature of the summer during the months of July and August has by far the

greatest share in the distribution of vegetable life in the northern regions, and the lowest temperature during those months is not found in the most northerly point yet reached by any exploring expedition, but in Winter Island, on the eastern shore of the Melville Peninsula, where the mean temperature during July and August ranges between 34° and 36° F. That spot, which may be called the phytological pole, is nevertheless covered with vegetation, and knowing as we do, that plants do grow not only on a frozen soil, but even, as in Kotzebue Sound, on the tops of icebergs, there is no reason to suppose that the terrestrial pole is destitute of vegetation. The most northerly berry-bearing plant yet recorded is *Vaccinium Vitis-Idæa*, or the cranberry, gathered in Bushman Island, on the northwest shore of Greenland, by Captain W. Penny, or in latitude 76° N., and longitude 66° W. The most northerly berry-bearing genera are *Vaccinium*, *Oxycoccus*, *Rubus*, *Cornus* and *Empetrum*. It is stated that occasionally berries ripen in Lapland. — *Quarterly Journal of Science.*

[We should think so! See Linnæus's "Lapland Flora," and his interesting "Tour in Lapland." In the former almost thirty baccate-fruited plants are enumerated, and at least half of these ripen edible berries. — EDITORS.]

THE FERTILIZATION OF WINTER-FLOWERING PLANTS. — Mr. A. W. Bennett contributes to the first number of the new scientific magazine, "Nature," the results of some observations on the fertilization of those plants which habitually flower in the winter, when there are few or no insects to assist in the distribution of the pollen. He finds that in those wild plants which flower and produce seed-bearing capsules throughout the year, as the white and red dead-nettles, shepherd's purse, chickweed, groundsel, etc., the pollen is uniformly discharged in the bud before the flower opens. Many garden-plants, on the other hand, natives of warmer countries, but which still flower with us in the depth of winter, never bear fruit in this climate, and in them the pollen is not discharged till the flower is fully open. Of this class are the yellow jasmine and the *Chimonanthus fragrans*, or all-spice tree; in the latter species the arrangement of the pistil and the stamens is such as to render self-fertilization impossible. — *Quarterly Journal of Science.*

ZOOLOGY.

A RARE DUCK. — A specimen of the Brown Tree Duck, *Dendrocygna fulva*, was killed in New Orleans on the 22d of January, 1870, and presented by Mr. N. B. Moore to the Smithsonian Institution. This is the first instance on record of the occurrence of this species so far to the east, although it has been known for some time as an inhabitant of California; in the first place, from specimens found by Mr. Hanters at Fort Tejou. The species occurs sparingly throughout Mexico and Central America and the eastern parts of South America, and is said to have been found nesting near Galveston, Texas, by Mr. Dresser. ***

External Gills in Ganoid Fishes.—Steindachner has discovered that in the two species of Ganoid fishes *Polypterus Lapradei* n. sp., and *Polypterus Senegalus* external branchiæ occur when they are young. In his new species, *P. Lapradei*, the branchiæ persist in individuals nineteen inches long. They consist of a long, flattened band, with fringed edges, very like the external branchiæ of the axolotls; there is a single one on each side behind the operculum, and it does not pass the posterior margin of the pectoral fin. In *P. Senegalus* this transitory organ disappears sooner, and is no longer to be found in specimens measuring three and a half to four inches in length. That these are respiratory organs has been proved by the anatomical investigations of Professor Hyrtl.—*Annals and Magazine of Natural History.*

The Limbs of Ichthyosaurus and Plesiosaurus.—Dr. Gegenbaur of Jena, has recently published an essay on the nature of the limbs of Ichthyosaurus and Plesiosaurus. He indicates that the homologies of the paddle of the former are best understood by reference to the fin of the Selachians, especially of the sharks, a most important point. He accepts the view of the great importance of the differences between its limb and that of Plesiosaurus. (In the American genus Polycotylus, though the type of limb is that of the Plesiosauroid, the ulna and radius are those of Ichthyosaurus; the vertebræ resemble also those of the latter.) He indicates that the serial relationship of the carpals, metacarpals and phalanges is to be traced to the corresponding segments of a primary—the radial—series, or ray. He thus lays the basis of the homology of subordinate radii of Protopherus and Bregmacerus, and of the fulcra of sauroid fishes, and therefore a basis for the estimation of the origin of the distal portions of limbs from the simplest form—the simple ray.—E. D. Cope.

The Organs of Hearing and Smell in Insects.—Mr. Lowne, in a recent work on the anatomy and physiology of the flesh fly, states his belief that the organ of smell is located in the third joint of the antennæ, which are remarkably dilated, and are covered with minute openings communicating with little sacs in the interior. The halteres he regards as the organ of hearing, their cavity being filled by a very large nerve terminating in nerve cells, which is connected with a number of small, highly refracting bodies, regularly arranged around the base of the organ. —*The Academy.*

Albino Barn Swallow.—In the month of July of last year, near Saco, Maine, I observed a flock of Barn Swallows (*Hirundo horreorum* Barton), one of the individuals of which was pure white or nearly so.—F. P. Atkinson.

The Sars Fund.—At a parlor lecture delivered in Salem by Mr. E. S. Morse, the sum of twenty-nine dollars and fifty cents ($29.50) was raised for the family of the late Professor Michael Sars, of Christiania. Liberal sums have already been subscribed in London and Paris.

GEOLOGY.

Discovery of a huge Whale in North Carolina. — Professor Kerr has discovered recently in North Carolina the remains of a huge whale some eighty feet in length, which I have recently studied. It is near Balæna, and very different from anything hitherto found. It has an extraordinary development of the supercilia. The ear bone is preserved. I have named it *Mesoteras Kerrianus*. — E. D. Cope.

The Geology of Brazil. — Professor C. F. Hartt of Cornell University, who has for several years been studying the geology of the coast region of Brazil, and has published two papers on the subject in the Naturalist, Vol. i, and a general rèsumè of his explorations in the "Proceedings of the American Geographical Society," and has an extensive work on the subject nearly printed, entitled "The Geology and Physical Geography of the Coast Provinces of Brazil," proposes to make a third trip to Brazil next summer. He will take with him several students from Cornell University, and the expedition will be one that in its results will, we doubt not, do credit to that institution which has already done so much in introducing full courses of scientific studies into college curriculums. The geology and natural history of Brazil have been largely studied out by university professors from America and Europe. Professor Hartt proposes to study especially the Amazonian drift, and doubts having been thrown on Professor Agassiz's theory of a great Amazonian glacier by several eminent geologists, we trust that this vexed question will be fully settled.

Professor Ward's Museum. — It will be gratifying to many of our readers to learn that the late fire has not proved an unconquerable obstacle to the indomitable energy of Professor Ward. Our own Museum has lately been augmented by the addition of a small collection of his valuable casts of unattainable European fossils, and we understand that he will continue to furnish casts and collections to colleges and institutions as freely as before the fire. Professor Ward also informed us that he was upon the point of departing again for Europe, where he expects to renew and add to his collections, both of actual fossils and of casts. His museum was fully insured, and as this has been paid, the losses can be, in a great measure, repaired, especially among the moulds, only one-third of the whole of these having been destroyed. — Editors.

ANSWERS TO CORRESPONDENTS.

S. L. W., New York. — Lichens, Nos. 1 and 3, *Leptogium tremelloides*; No. 2, *Pannaria microphylla*; No. 4, *Endocarpon miniatum*, two specimens, one of which is *E. glaucum* Ach., but only a variety; Nos. 5 and 6, *Cetraria lacunosa*; No. 7, *Urceolaria scruposa*; No. 8, *Parmelia saxatilis*. The *Usnea* without a number is *Usnea rubiginosa* Mx., a variety of *U. barbata*. — J. L. R.

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THE INDIANS OF CALIFORNIA.*

BY EDWARD E. CHEVER.

Fig. 34. Indian stalking an Antelope.

THE name "Digger," which Fremont gave to the Indians that he found on the eastern slope of the Sierra Nevada, a

* Read before the Essex Institute, February 21, 1870. An abstract will be found in the "Bulletin of the Essex Institute" and a vocabulary of such familiar words as Mr. Chever was able to recall. It is but justice to our author to state that his familiarity with the language of the tribes, during five years of friendly personal intercourse, has given him a rare opportunity of forming a correct judgment of what these Indians really were before they were demoralized by contact with the whites, and that he has confined himself to such statements as he remembered clearly and knew to be correct. —EDS.

Entered according to Act of Congress, in the year 1870, by the PEABODY ACADEMY OF SCIENCE, in the Clerks Office of the District Court of the District of Massachusetts.

people who obtained a precarious subsistance in winter by digging through the snow for roots, and searching the rocks for lizards, and who had neither villages or numerical force, has been applied by the readers of Fremont's work to all the Indians of California.*

The name was really applicable to those whom he first met with, but not to the Indians living on the other side of the mountains, who spoke a different language and were more provident than those living on the great plains east of the Rocky Mountains. The latter have been much more destructive to the whites in battle, having procured, at an early date, firearms from Indian traders. The gold excitement, however, settled California so rapidly that the Indians were in a hopeless minority after the first immigration crossed the continent, and excepting where their villages were attacked they had no wish to fight, for they had no surplus population to lose.

That these same Indians were not wanting in courage or spirit I have had repeated proofs.

They would attack the sturgeon when under water and drag him to the shore with their limbs bleeding from the sharp spikes. I have also seen Indians bearing the scars of conflicts with grizzly bears, and the frequent instances of white men scarred with wounds made by their arrows, shows that they contended courageously with the early settlers.

The Indians of California, in 1849, were the more interesting to the ethnologist from the manner in which that country had been settled. The Jesuits, it is true, had been in Lower California for many years, and had established mission schools there, and a few Europeans had a short time before made scattered settlements in the Sacramento Valley, but the whole country was so remote from our frontiers, and inclosed by the intervening barriers of the Rocky Mountains

* The Indian tribes of the section I am describing, called themselves respectively, Sesum, Hocktem, Yubum, Hololipi, Willem, Tankum, and inhabited the valley of northern California, between the Sierra Nevada and the Coast Range.

and the snows of the Sierra Nevada Range, that it had been but little changed since its discovery by the whites. Many Indian tribes were living in as perfect a state of nature as the elk, deer or antelope, which furnished them with food. A head-dress of feathers with a scanty coat of paint on his face was the full dress of a brave, while a fringe made of grass, or fine strips of bark, from the waist to the knee, was the costume of the girls or women. The Indians had but little beard naturally, and excepting in a few cases where old men had grown careless of appearances the hairs were pulled out; sometimes a pair of muscle shells were used as tweezers, although I have seen a squaw dip her fingers in ashes and pull out her husband's beard, and draw tears at the same time from his eyes. Both sexes wore ornaments in the ears, but not rings. The children had their ears bored when quite young and small sticks inserted; these were exchanged from time to time for larger sticks, until a bone ornament, made from one of the larger bones of a pelican's wing carved in rude style, and decorated at the end with crimson feathers, could be worn permanently. This bone was about five or six inches long and larger in size than my little finger. The back hair of the men was fastened up in a net, and this was made fast by a pin of hard wood pushed through both hair and net, the large end of the pin being ornamented with crimson feathers, obtained from the head of a species of woodpecker, and sometimes also with the tail feathers of an eagle. The women used no nets for their hair, nor wore feathers as ornaments, excepting in the end of the bones used by both sexes for the ears, which I have already described. The children were naturally frank and the girls gentle and confiding, not much more so, perhaps, than young grizzlies, but then I doubt whether the cub's mother threatens to give it to a white man, if it proves disobedient, and a white *man* was the *Bugbear* used to frighten papooses into good behavior. They were allowed much freedom, however, in seeking amusement or instruc-

tion; the girls acting as nurses to the younger children, and taking them off in the woods or to the river where they bathed, and the babies allowed to crawl in the water before they could walk on land. An Indian could no more remember when he learned to swim than when he first stood on his feet. When the children were disposed to be good natured the girls petted them as kindly as our children tend dolls, but if they were cross, in spite of their caresses, they threw cold water in their faces until their tempers cooled. The girls fully equalled the boys in swimming or diving, and also used the paddle with skill, sometimes even beating the boys in their canoe or foot races. The boys, however, soon took to their bows and arrows, wandering off to hunt, and the girls learned at home the art of weaving baskets and making bread of acorns. Familiar with the points of the compass from infancy, they use their knowledge on all occasions; even in play, if a ball or an arrow is being searched for, the one who saw it fall will guide the seeker thus, "to the east," "a little north," "now three steps north-west," and so on. In the darkest night I have known an Indian go directly to a spring of water from a new camp by following the directions of a companion, who had been there previously, given perhaps as follows: "three hundred steps east and twenty steps north." This early training in woodcraft gives that consummate skill and confidence which is rarely acquired by those who learn it later in life. In tracking game they know the "signs," as our hunters call them, of the various animals and birds as well as they know the kind of game that made them, and experience teaches them when the animals moved away. In tracking white men they cannot make mistakes. The white man's foot is deformed, made so by the shape of his boots or shoes, and even when he is barefooted his toes are turned inwards. The Indian's foot, never having been compressed, has the toes naturally formed and straight as our fingers are, and he can even use them to hold arrows when he is making them. When he walks therefore, each

toe leaves its impress on the dust or sand, the imprint of the little toe being as straight, perfect and distinct as that of the largest. In summer the Indians are fond of travelling from place to place as fish or game, sunny nooks, or shady glens offer their attractions in turn, and this *living* in different places accounts in part, for the intimate knowledge they possess of localities and also of trails leading from one section to another.

In the event of exposure to a severe storm when out hunting, or on a journey, the Indian does not risk his life by exhausting his strength. He selects the best shelter near him while he is comparatively fresh, and with bark or boughs, or under an overhanging rock, seeks protection from the wind. A hole sunk in the ground, and a small fire kept burning by an armful of sticks, will keep him warm till he can resume his journey. The Indians use great skill in their selection of fuel, and also in the disposition of the sticks in burning. They say of the white man "big fool, make heap fire and smoke, stand far off, look at him burn, while freeze." The Indian rejects green or wet wood and puts a few dry sticks together, with the ends towards a centre. This gives a free circulation of air between the brands, with but little smoke, and a large proportion of heat for the size of the fire. Their winter quarters are dry and warm, but are rarely free from smoke, which the Indians do not seem to regard as an inconvenience. The outside is covered with earth and at least a half of the hut is below the surface of the ground. The inside shows strong posts supporting an arched roof made of poles bound with grapevines, and these covered with reeds and coarse grass secured by cords. A small hole in the roof serves as a chimney, and a low door, usually on the south side, is kept open excepting in stormy weather. A raised platform of poles and reeds holds the skins and blankets used for bedding. These blankets, made from geese feathers woven so as to bring the feathers overlapping each other, are ingeniously made, and are a protection from wet or cold.

When the Indians leave their houses a branch is left in the door to show that no one is at home. The California Indians were more provident than most of the aborigines of this country. Large, round, upright cribs, made of poles and reeds, perhaps eight or nine feet high, contained their supplies of acorns. These cribs were neatly made and had a floor of loose reeds to keep the acorns from contact with the ground; they were estimated to hold two years supply of breadstuff, and were filled when acorns were abundant to provide for a short crop if the next year should prove unfruitful. The whole tribe, men, women and children, worked together in gathering acorns in the fall for these public granaries. The hunting and fishing were done wholly by men, and some of the fishing was done at night when the women were sleeping at home. Much of the drudgery came to the women and seemingly with their consent. They said that a hunter needed a keen eye, a firm hand and a fleet foot; if he became stiff from hard work or lost his skill, his wife must suffer with him in his misfortunes, and it was best for each to do what each could do best.

The position of honor among the Indians is the recognition of excellence in some quality or acquirement. This induces every young man to improve himself by every opportunity offered, so that he may become the first in usefulness and be called on to meet chiefs in council. When the customs of the Indians are learned the charge of indolence, as often made against them, does not seem wholly merited. One of the early settlers in New York asked a chief why he did not work and lay up money. The chief replied that he wanted one good reason given him why he should make a slave of himself all of his life to make his children lazy for the whole of theirs. The labor performed is often great and exhaustive and must be shared by many. As no one gains any advantage over his fellows, excepting as he may prove himself more useful to them by the exercise of superior skill, he has less inducement to work alone, as a

public servant. The Indian again has a desire to have game abundant, and to have the trees preserved for his acorns and fuel. It would seem folly to kill game faster than needed for food from year to year, and cutting down the oak that brought him acorns, would be killing the goose that laid the golden egg. An Indian to be judged fairly must be regarded as an Indian. Custom with them, as with civilized people, is law, and many of their customs have probably been transmitted, with but little change, from remote ages.

Fig. 35.

Indian Village.*

There is every reason to believe that the Indians were very numerous in California at some former time. Deserted mounds, showing the sites of former villages, are seen along the banks of the rivers, and a few tribes, speaking dialects of their own and yet living separately as nations, only consist of a dozen families each. One of these removed to a large tribe while I lived near them and remained as a part of the more powerful tribe for a year or more; but they became discontented or homesick, and returned to the village con-

*The grain cribs are scattered about among the huts, and the poles planted in some of them support the decoys used by the Indians in shooting geese. — Eds.

taining the dust of their ancestors. Here they kept up the traditions of their fathers, and related tales of former glory, and prayed to the Great Spirit for success and for abundant blessings. It is worth our time perhaps to consider, while speaking of the mounds that indicate the sites of villages, how much of the elevation is due to natural deposits, and whether it may not in many cases be entirely so.

The streets in the city of Chicago have risen from eight to ten feet above the old level during the past twenty-five years from the soil obtained from cellars, ashes, sweepings, etc. Even the villages (so called) of prairie dogs are made higher by their occupation. The ground used as a permanent home by human beings is constantly receiving additions from the wood used as fuel, bones of animals, shells of various kinds, and even the bodies of the California Indians were buried near their houses, with their baskets and implements used in hunting and housekeeping. I am aware that elsewhere mounds seem to have been heaped up by another race of people, but the highest that I have met with in California I think were owing to the gradual accumulations from centuries of occupation.

The traditions of the Indians are so fanciful, when they get beyond the history known to the living, that they differ but little from printed fictions.

Their religion is probably little changed from that of an earlier age. A Good Spirit is invoked to provide food and give prosperity, and evil spirits are to be propitiated. The oldest chief prays at certain seasons, morning and evening, outside of the council lodge, and sings in a monotone a few sentences only. This is not in words taken from their language, but is supposed to be intelligible to the Great Spirit. When special prayers are made for success in fishing or hunting, the request is made in plain Indian. Although he prays constantly for success, he uses wonderful craft and skill to ensure it. The antelope could not be approached in the short, dry grass on the plains even by crawling, but the In-

dian whitens the sides of his body with clay, and puts a perfect decoy antelope's head on top of his own.* With a short stick in his left hand to give length to the pretended foreleg, and carrying his bow and arrows in his right, he pretends to feed contentedly on the grass until the antelope approaches sufficiently near for him to kneel and shoot. The hunter, when standing or walking, supports himself on the short stick held in the left hand, like an animal standing on three legs (Fig. 34). I found by adopting this decoy head, and wearing knit clothing, that the antelope would come to me readily if I would remain in one place and hold the head near the ground, as if feeding. It was more difficult to walk far in this way, and the antelopes would come to me at times when if I had attempted to go to them, they would have become alarmed.

To illustrate the ease with which an Indian can provide food for himself, I saw one come to the bank of Feather River one afternoon and start a fire. Turning over the sod and searching under the logs and stones he found some grubs. Pulling up some light dry reeds of the last year's growth he plucked a few hairs from his own head and tied the grubs to the bottom of the reeds, surrounding the bait with a circle of loops. These reeds were now stuck lightly in the mud and shallow water near the edge of the river, and he squatted and watched the tops of his reeds. Not a sound now broke the quiet of the place; the Indian was as motionless as the trees that shaded him. Presently one of the reeds trembled at the top and the Indian quietly placed his thumb and finger on the reed and with a light toss a fish was thrown on the grass. The reed was put back, another reed shook and two fish were thrown out; then still another and the fellow was soon cooking his dinner.

The spearing of salmon by torch-light, is very exciting.

* This is the real skin of an antelope's head with artificial horns made from tulé covered with a paste composed of the bulb of the soapweed pounded with charcoal; the eyes are made of the skin stripped from the back of a woodpecker, with the purple black feathers attached.

It is done on moonless nights and usually in parties of three to each canoe. One Indian guides the boat, a boy kneels in front with a blazing torch held near the surface of the water, while the one with the spear watches for the flash of the salmon as he darts toward the light. The spear is a loose point of bone with a hole through the centre, and one end fitted in a socket at the end of a light strong pole, and secured to the staff by a cord through the centre of the bone. When a fish is struck the bone is drawn out from its socket and left in the fish, making what sailors call a "toggle," the cord holding it in spite of its struggles. When the Indian is about to spear the salmon, you see him to advantage, and he gives his orders full of earnestness. "Hoddom! Hoddom! Pue-ne! Pue-ne! Hon-de! Hip-pe-ne! Mip! Mip! Wedem-pou!" as the struggling fish is drawn to the canoe. These words translated are: There, there! East, east! Lower! Higher! Hold, hold! The last word is an exclamation of surprise.

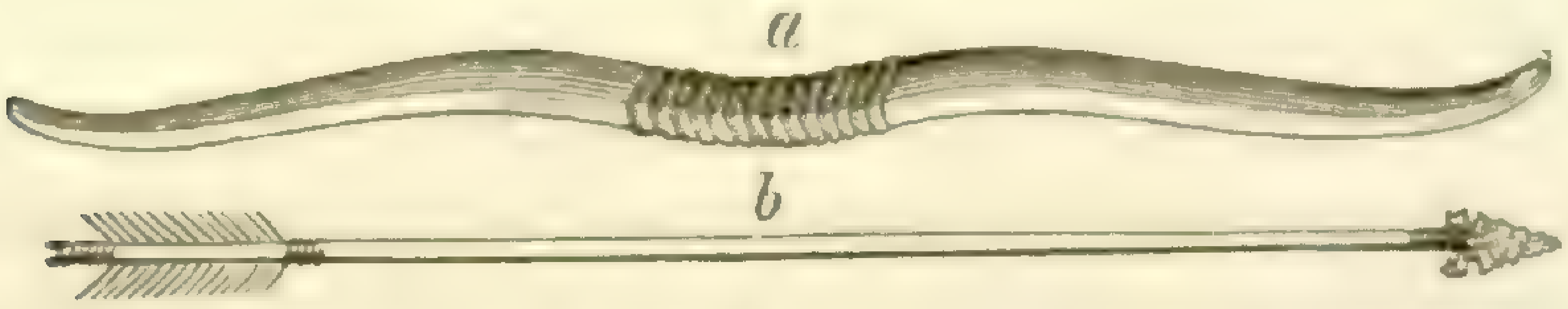
No christian has stronger faith that his Father will provide for his wants, than these Indians had that the Great Spirit would send the salmon into their nets, or the grasshoppers to vary their bill of fare. Although grasshoppers are regarded with dread by the white settlers in some sections, the Indians go out to meet them rejoicing. They pile up the dry bunch grass for a centre and then forming a wide circle, and swinging branches of trees, they advance driving the swarms of grasshoppers, until they take refuge under the pile of bunch grass. The grass at every point is set on fire simultaneously, and burns like gunpowder. When the smoke has rolled away the roasted grasshoppers are picked up by the basket full.

The division of fish and game was made generally by a chief, who counted out as many portions as there were families to eat. If no objection was made to the size of any portion, one of the number turned his back and called out some name as each lot was pointed out by the chief, the Indians

removing their share as fast as called for. No complaint was made if some were sharers who had not been workers, and hospitality to those entering their lodges was universal.

The Indians hunt for one kind of game only at a time, and each kind when they can be taken most advantageously.

Fig. 36.

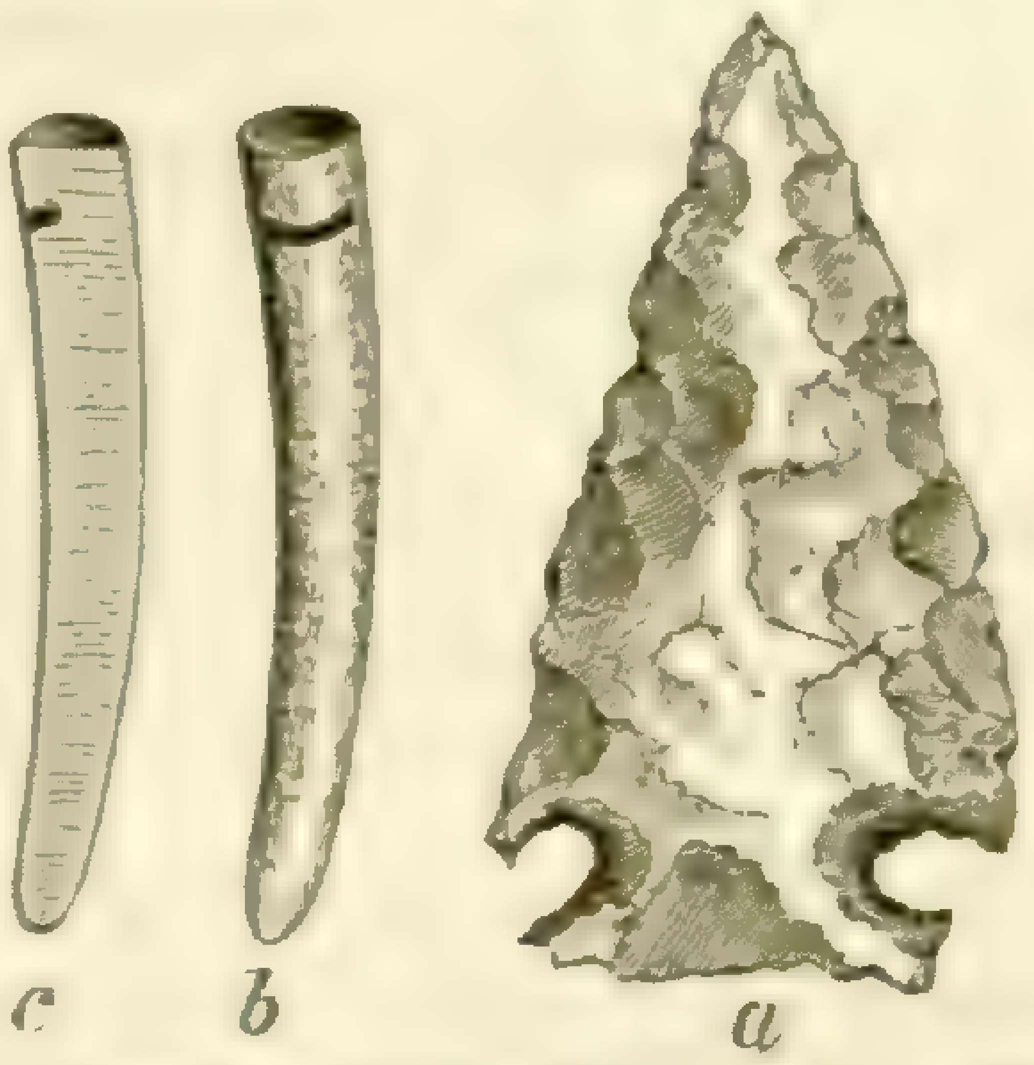


a The bow unstrung, from the Museum of the Peabody Academy.
b Arrow with head of obsidian, from the same.

When I saw every kind of game represented together at the Indian encampment in Bierstadt's celebrated painting of the Yosemite, I knew the camp had been introduced for effect, from this evident ignorance of, or disregard for the habits of Indians.

The Indian bow (Fig. 36) is made of the tough mountain cedar, with a thick back of sinew. A string of sinew also enables him to draw an arrow nearly to its head before it is sent humming through the air. The arrows are of two kinds, those with a head of hard, pointed wood for common use and those (Fig. 36 *b*) reserved for extreme cases of attack or defence, having points of agate or obsidian, which are carefully kept in the skin of a fox, wild cat or otter. The stone arrow-heads (Fig. 37) are made with great care, and the materials from which they are made are often brought from long distances. Obsidian and agate are probably selected not so much for beauty of coloring as for their close grain, which admits of more careful shaping. They use a tool with its working edge shaped like the side of a glazier's diamond. The

Fig. 37.



a Arrow-head of obsidian, from the Museum of the Peabody Academy.
b Instrument for chipping the obsidian.
c Section of the same.

arrowhead is held in the left hand, while the nick in the side of the tool is used as a nipper to chip off small fragments. An Indian usually has a pouch of treasures consisting of unfinished arrowheads or unworked stones, to be slowly wrought out when industriously inclined. The feathers are so placed on the arrow as to give it a spiral motion in its flight, proving that the idea of sending a missile with rotary motion is older than the rifling of our guns.

Fig. 38.

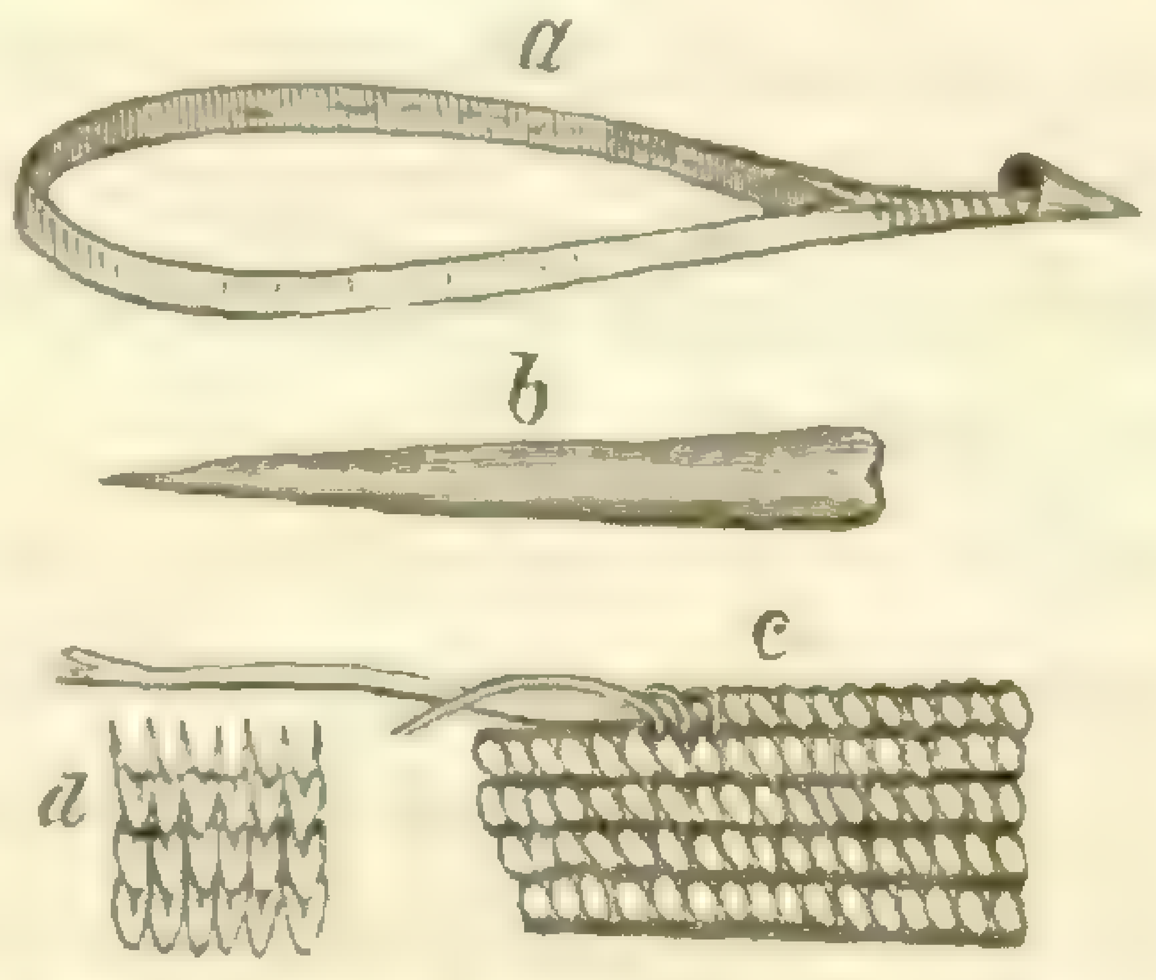
a Cooking or water basket.
b Flat mat used as a plate or tray, and this also shows how the bottoms of the baskets are formed.*

It would consume too much space to describe all their implements, and many of them do not differ materially from those that were used by Indians in this section; among them were awls of bone, thread of deer sinews, and cord which they used for their nets, bird traps, and blankets; — this cord was spun from the inner fibre of a species of milk-weed. Their cooking utensils were made from the roots of a coarse grass. These roots grow near the surface of the ground, and in sandy soil can be pulled up in long pieces. The pulpy outside skin is removed and the inside is a woody fibre, extremely tough when green, and durable when made into articles for daily use. The Indian women split these roots into thin strips, keep them in water when they are making baskets, and take them out one at a time, as needed. The water basket is first started from a centre at the bottom, and is added to stitch by stitch, without a skeleton frame to indicate the intended size (Fig. 38). A loose strip of grass root is added constantly as a new layer to the last rim, and this is sewed on with another strip of the same fibre to the finished work beneath, a bone awl being used to bore holes through the basket portion. The last rim or complete edge of a basket has a larger filling, consisting of several strips of split grass roots, or sometimes a willow stick is used. The larger baskets are ornamented with

* The radiating line in this figure are incorrect.

figures woven in of a darker color; the girls sometimes add beads and feathers for smaller baskets (Fig. 39). The conical baskets used for carrying burdens is *woven* instead of being sewed together, and is of looser texture and lighter in weight (Fig. 40). They are quite durable, however, and are used to carry wood, acorns, or household goods on a journey. The water baskets were also durable and would hold hot water.* Water was made to boil in them by dropping in stones previously heated. The women skilfully used two sticks in handling hot stones or coals as we would tongs.

Fig. 39.



a The yoke used to carry the conical basket.
b The awl used in sewing the basket.
c Fragment of basket from the Museum of the Peabody Academy, showing the character of the stitch used on the outside.
d Inside view of the same, showing that each stitch from above run diagonally through the one below it of the last series, and is brought out between the threads on the outside.

Fig. 40.

Woman carrying a burden basket.

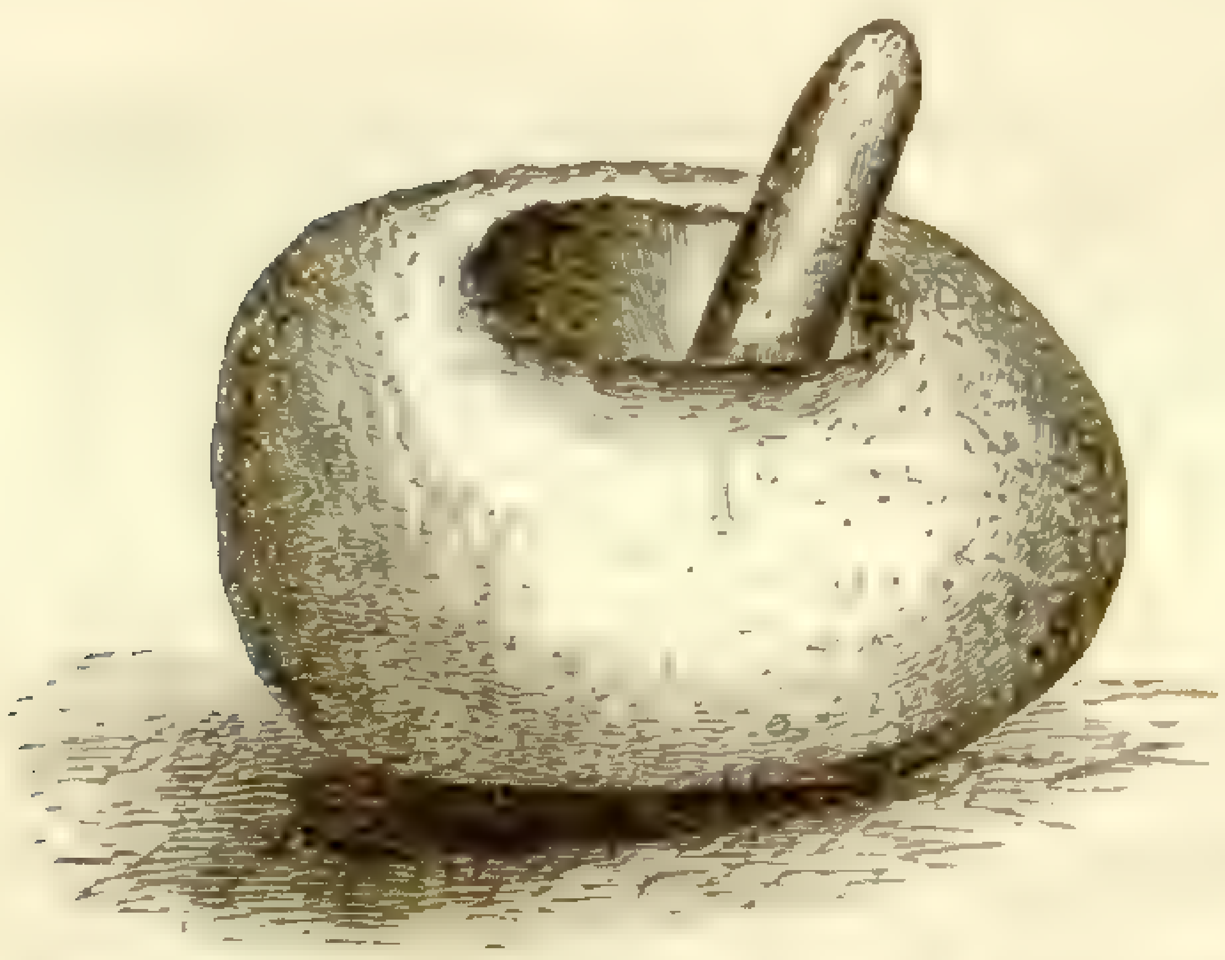
In bread making the women pounded the acorns between two stones, a hollowed one serving for a mortar (Fig. 41), until it was reduced to a powder as fine as our corn meal. They removed some of the bitterness of the meal by scraping hollows in the sand and leaching it, by causing water to percolate slowly through it. To prepare it for cooking the dough was wrapped in green leaves and these balls were covered with hot stones. It comes out dark colored and not appetizing, but it is nutritious and was eaten with gratitude by Fremont's men in 1844. Fish and meat were sometimes cooked in this way. A salmon rolled in grape leaves and surrounded with hot stones, the whole covered with dry

* A shallow basket of their work, which has been in the Museum collection for years, now holds cold water as perfectly as when it was made. —EDS.

earth or ashes over night and taken out hot for breakfast, does not need a hunter's appetite for its appreciation.

Marriage among the California Indians was similar to that of other tribes in other parts of the country. Presents of sufficient value were given by the man to the girl's parents, and the bride might be given away without her knowledge or consent. From my own observation I know that the Indian uses the best of his judgment in making a selection, and desires neither family strife or misery in his lodge. Girls are married at thirteen or fourteen years of age, and no woman of marriageable age remains single long. Most of the Indians, who became personally well known to me, were very happy in their family relations, and the custom of dividing food equally among them, allowed no family to suffer from want.

Fig. 41.



Stone mortar and pestle, from the Museum of the Peabody Academy.

When the whites first came into the country the Indians were virtuous and happy, and if whiskey had not demoralized them they would have retained much of their original independence and self-respect. They were naturally cheerful and attached to each other, and although polygamy was permitted I knew only one chief who had two wives. These seemed to agree, although Waketo said of his family that it had "too much tongue."

In earlier days dancing among them was confined to ceremonies of different kinds. In some of these the women joined, forming themselves into a circle; but as only one step was used in a solemn way, accompanied by a half turning of the body, a stranger might be in doubt whether it was rejoicing or mourning. Within this circle the men danced with great activity, leaping across a fire burning in the centre, and yelling and singing whilst the women

continued their solemn dancing, singing a low monotonous chant.

Running of races was confined, after childhood, to the men, and endurance rather than speed sought for. A race was for three or five miles at least, and a good runner would follow a runaway horse or mule that had started off with greater speed, but in a few hours would return with the animal in his possession.

The Indians were inveterate gamblers, and parties from one tribe would visit another for several days at a time and play day and night. The game was a sort of an "odd and even," as played by white children, the parties guessing as to the number and position of the sticks used in the game. The playing was accompanied by singing, and beads were principally used for stakes.

In the treatment of diseases the Indians succeeded in a certain class of them, but failed altogether in others. The pain from a sprain or rheumatism would be drawn to the surface by burning the skin with fire. I can testify to a cure from this remedy. A severe sprain of an ankle, followed by two months use of crutches, resulted six months later in rheumatism in one of my feet. The assertion of a chief that fire would cure it in an Indian, but for a white man—and here he shrugged his shoulders as if words were unnecessary—induced me to try the experiment, and show him that white men could bear pain. I placed a live coal on the top of my instep, and before the burn was healed my rheumatism was gone. For headaches they pressed their hands on the head of the sufferer and sometimes cured it by gentle pressure. For other diseases they tried steam baths, especially for colds. When any internal disorder defied their treatment, they immediately begged medicine from the whites.

In burying the dead a circular hole was dug and the body placed in it, in a sitting posture, with the head resting on the knees. If a man his nets were rolled about him and his

weapons placed by his side. If a woman her blanket enclosed her body, and a conical shaped basket, such as they carry burdens in, was put in the grave also, with the peak upwards. The widow of an Indian cut her hair short and covered her head with ashes, and in the mountains they used tar for that purpose. Every night for weeks, after their bereavement, the wails of these women were distracting. I do not know the exact time prescribed for mourning but I do not think it lasted more than six months.

The language of the California Indians is composed of gutteral sounds, difficult to separate into words when spoken rapidly, and hard to pronounce or remember. The counting is done, as with all primitive people I have met, by decimals. Children in reckoning call off the fingers and toes of both hands and feet as twenty, when wishing to express a large number. In counting ten the following words are used: Weekum, Paynay, Sarpun, Tchuyum, Marctem, Suckanay, Penimbom, Penceum, Peleum, Marchocom. If eleven is to be expressed it is Marchocum Weekum, or Ten one; Marchocum Paynay, ten two, and so on to twenty which is Midequekum. The general term for man is Miadim, and for woman Killem, and for a child Collem. A boy is Miadim collem and a girl Killem collem. Although this seems to indicate a poverty of distinctive terms, yet when it is found that every animal, bird, insect and plant has its own name, it will be seen that there is no want of materials to supply a stranger with words for book making, if his tastes lead him in that direction.

After many years passed with these Indians, and having every opportunity to study their customs and character, I entertain pleasant recollections of their friendship which was never broken, and feel sadly when I realize that the improvements of the white men have been made at the sacrifice of Indian homes and almost of the race itself.

Feather River (Rio de Plumas), before its mines were washed for gold, was so clear that the shadows reflected on

its surface seemed brighter than the real objects above. The river abounded in fish, as did the plains on either side in antelope, deer, elk and bear. The happy laughter of children came from the villages, the splash of salmon, leaping from the surface, sent ripples circling to the shore, and the blue dome of heaven was arched from the Sierra Nevada with its fields of snow on the east, to the distant Coast Range that shut out the Pacific on the west. Grand oaks, with far spreading shade, dotted the plains that stretched for miles on either side, and in spring time the valley was brilliant with flowers. This was the possession and home of the Indians, whose ancestors had lived and hunted without patent or title obtained from deeds, long before the first sailor planted his flag on the sea-coast,and claimed the country by right of discovery. It could not be expected that the Indian would see his trees cut down and game destroyed, and the clear rivers turned into muddy streams, without regret. That they refrained from seeking satisfaction for what they regarded as intentional wrong is more surprising.

A white woman told me one day of her spirit in driving an Indian from her tent, by getting out her husband's pistol and ordering him to "vamose." The Indian's story was heard in this particular case, and never having seen a white woman before he was astonished at her hostile intentions, and indignant at having been threatened when he intended no wrong. He added that he knew now "why so few of the white men in California were married."

The Indians are philosophical by nature and accept either death or suffering, when regarded as inevitable, with composure. On one occasion, when talking with a chief, and slapping mosquitoes with considerable energy, killing them when I could, the Indian remained cool and serene, quietly brushing the little torments from his limbs, and observing my impatience, said, "what good comes of killing a few, the air is full of them." When the first steamboat passed the Indian villages I watched the Indians to see what effect

it would produce, but to my disappointment it did not excite them or elicit any expression of wonder. Even the steam whistle failed to move them; they did not understand it and would not exhibit surprise. Two years later a brig sailed up the river and the Indians were full of excitement. The size of the sails and the strength of the ropes came within their comprehension, filling them with wonder. The task of gathering fibre enough to weave so much cloth, and such ropes, made the white man a wonderful worker in their estimation.

It has been customary to attribute certain general qualities to whole tribes of Indians, and this has been done to those of whom I have written. I can only say that no two Indians of my acquaintance were alike, and their mode of life would naturally develop individuality of character.

The charges of lying and stealing, as urged against them, have some foundation in fact, although the Indian might make some such defence as our soldiers made to the accusation of theft of honey and chickens while marching through the South during our late war. They did not steal, they *took* what they wanted and expected to live on the enemy. No Indian can steal from his tribe, however, without losing his character, and their desire to have position in the tribe makes both men and women as careful of their reputations as those in civilized life. Indians and white men cannot live side by side happily, nor without fighting till the white man is acknowledged master. The Indian is cat-like, attached to localities, and kills only such game as he needs for food; he is stealthy by nature, and patiently waits his opportunity to strike. The white man is migratory and carries his attachments to strange lands, making his home where his ambition or nature attracts him, and is destructive alike to game or forests. The Indian, if he become an obstacle, is classed with wild animals, and is hunted to the death; this antagonism becomes mutual and is perhaps as natural as the antipathies of cats and dogs.

The early settlement of New England was attended by the horrors of Indian warfare, and this struggle is the same to-day as then, but farther west on the plains of Colorado and Arizona. The Indians of California are now fed on government rations, and instead of elk and antelope the land is grazed by herds and flocks of domestic animals owned by the white men, and enumerated and taxed as one of the largest items of wealth in a rich state. The present policy of the government of removing Indians from disputed lands, and settling them upon reservations, is perhaps the best thing that can be done, but much of the management of Indians in the past has been a shameful record of fraud, by the agents of our government who represented the public money-bag, and of outrages committed on emigrants by the Indians.

Many of the Indian agents, in their greed for gain, supplied hostile tribes with rifles, ammunition and whiskey in exchange for furs and even property captured from the white settlers. Whisky that may only make a fool of the white man converts an Indian into a fiend, and when drunk he may kill friend or foe. The individual settler, exposed to attack, regards the Indians as brutal and dangerous, and loses faith in his government if it rewards with presents the wretch who has murdered his companions, and may at any time attack him by surprise and butcher his wife and children.

Our government is now powerful enough to warrant the exercise of authority and mercy. It is folly to purchase peace of such a people by paying them tribute, as the Indians themselves seek to propitiate evil spirits by gifts of beads; and it cannot be right to make "Black Kettle" a present of a Colt's revolver, after he has already used his rifle and knife on more white victims than any brave of his tribe.

The Indians whom I have particularly described in this paper, have been shown to possess the virtues of generosity and hospitality without the least knowledge of Christianity, and

it is a mortifying fact that the early explorers in this country generally found welcome and hospitality among the Indians before the white traders had corrupted them. Now it is difficult to find a tribe that a white man cares to visit unless with the balance of power on his side. Indian cunning even has not proved equal to the duplicity of the white man. You may have heard of the Indian who offered his beaver skins for sale to a trader in olden times in one of our Puritan villages, when the trader was on his way to church. The trader would not purchase then, but in a whisper stated a price. When the church was dismissed the Indian followed the trader home and demanded payment for his skins, but was forced to accept a less price than was first named. The Indian took the money but told an acquaintance that he had discovered the use of the big meeting at the church,—"it was to lower the price of beaver skins."

As a white man I take the side of the pioneer in defence of his family, but I wish the Indians could have been spared much of the degradation brought upon them by bad white men that must eventually end in complete subjection, or extermination.

NOTE. All the figures not otherwise designated, are drawn from memory. — EDS.

THE TIME OF THE MAMMOTHS.

BY PROF. N. S. SHALER.

WE must ask the reader to go with us into the remote past; back beyond the time when man invaded the primitive forests and disturbed the abundant life which covered the prairies around the great inland seas of our continent; still farther back until we come to a time when very different animals from those now living there, roamed those woods and fields. We thus come to a time remote when measured

by the usual standards of duration, yet only a geological yesterday. Once such journeys as we propose making were very difficult, and attended with dangers to soul, if not to body, which might well make any but the stout hearted investigator hesitate. But now that the wall, which once divided the preadamic time from the present, has been so frequently breached and trodden over by those bound on expeditions into an even more remote past than that to which we seek to penetrate, we may set out on our journey without fear of meeting with a reception, on our return, which might make us wish that we had stayed among the monsters of that ancient time.

We will not strain the imagination of the reader by asking him to conjure up a picture of land and sea unlike that given by our present continents and oceans. He need not flatten out mountain chains, or dry up river systems, in order to represent to himself a true picture of the theatre which bore the actors of the scenes we are about to describe. Our good old continent was much the same then as now. All the changes which have taken place would fall within the limits of error of the maps of the past few decades. The unceasing agents of change operating through water, have done much work; but a little longer delta to the Mississippi, a somewhat greater projection of Florida to the southward, a lessened area of the great lakes of the north-west, are about all the more important changes which have been accomplished since the time of which we speak.

In order to come in contact with living elephants and mastodons, we need not go so far into the history of our continent as to traverse the glacial period. Long after the time when this great ice envelope shrouded the northern half of this continent, the great pachyderms continued to form the most important feature in the life of our continent. If we wish to go back to the time when these great animals first came into our fields and forests we must ascend much farther into the past, beyond two or more glacial periods.

with the long intervals of repose between them. During the middle and later tertiary periods elephantine life had its highest development; a half a dozen or more species lived then on the surface of the European continent, and only a portion of the then existing forms may be known to us. The importance of the elephant life of this time may be better estimated by comparing the number of large mammals belonging to any one family now existing in the same area. Only three or four species of the family of cervidæ, to which the common deer belongs, have existed in Europe since the glacial period. Among the bulls not more than two species are known to have lived during the same time. Nor among the large carnivora, the bears or wolves, have the species been more numerous. We must seek among the smaller of the existing mammals, among the squirrels or mice, for the same richness in specific representation as we find among the elephants of the tertiaries. The variety in size and form seems to have been very great; the smallest species was not over three or four feet high, while the largest stood as high as any of our living elephants, towering to the height of ten or twelve feet. We know too little of the geology of the other continents of the old world to say whether this exceeding richness in large elephants at this stage of the earth's history was also found there. We know, however, that India, where one of the two remaining species of elephants lives, was thronged with these animals at this time, and although Africa was probably then separated from the other continents with which it is now closely united by seas of considerable width, it, too, probably bore an abundance of the same life. We do not know the character of the life of the middle tertiary time in North America with anything like the accuracy that we do that of Europe during the same time. The investigations which are to enable us to form a clearly defined picture of the life of that time, on our own continent, are yet to be made. It seems likely, however, that during the time when elephants were so remarkable a feature in the life

of the old world, the new world was inhabited by quite different forms of pachyderms. The beds of the Mauvaises Terres, and neighboring country so astoundingly rich in animal remains, have supplied us with more species of fossil horses than are known from all the rest of the beds of that period. Altogether the middle and later tertiaries of North America have supplied us with the remains of at least ten species of fossil horse-like animals; so that the comparatively unexplored regions of North America have yielded more tertiary horses than all of every age and formation which have been found in other regions.

When we come down to dates nearer to our own time, and only separated therefrom by the last ice period, we find evidences that the European elephantine life still continued, though the species had changed, there being no longer so considerable a number of distinct forms as then existed. We are not yet quite certain whether the elephant remains of Siberia come down to us from a period anterior to the glacial epoch, or whether they were stored away in that frozen soil during or since that time of extreme cold. All analogy with the remains found in other regions, lead us to conclude that these herds of elephants, whose remains are found in such abundance around the mouths of the great rivers of northern Asia which empty into the Arctic Ocean, are contemporaneous with those of the closely allied, if not identical, species found in the peat swamps and morasses of North America. The number of these fossil elephants which are to be found in northern Asia is as remarkable as the condition in which they have been preserved. The ivory which they have left strewn over this region has been for centuries an important article of commerce, a large portion of the Chinese supply being probably derived from this source. There can be no doubt that the elephant life of this region was once as abundant as that which now exists in the jungles of Ceylon, or the southern part of Africa.

The peculiar circumstances under which many of the bod-

ies of the Siberian elephants have been preserved, enables us to form an idea of the external form and habits of the creature far more satisfactory in its character than that which we have of any other extinct animal, except a few which have been exterminated by the hand of man.

Generally the geologist is compelled to effect the restoration or rebuilding of the form of the extinct animal from fragments of a skeleton, the gaps of which he must fill by inference, and this conjectural framework is afterwards to be thrown into a more or less imaginary outline of soft, enveloping parts. He is only too thankful if he finds that decay has left him a tolerably fair basis which he may build his labor upon. But in the case of many of the Siberian elephants the preservation is perfect; not only the skeleton, but the whole mass of the soft parts; the external envelope of skin, with its protecting covering of hair; even the delicate and perishable structures of the eye, an organ which so quickly perishes when decay begins to work, are all in an unchanged condition. Nor is the preservation that of form alone; the chemical condition of the body is unchanged, it is still flesh and blood; its imprisonment in the ice of the frozen soil of the Lena delta for an hundred thousand years, more or less, has not perceptibly changed its constitution; animals feed greedily on this flesh which has endured twenty times as long as the historical record. The dogs and wolves gather from afar to the feast whenever one of these bodies is uncovered, and there seems no good reason why those abnormal appetites of Paris, which find a new titillation of the palate in every monstrosity of diet, should not get a sweeter morsel from these preadamic elephants than they have obtained from their choice pieces of the knackers yard. Fortune certainly awaits the next rival of the *hois treres Provenceaux*, if he will bid for it with elephant steaks from Siberia. The many ingenious inventors, who seek to find a means of preserving substances liable to perish by decay, who are constantly endeavoring to solve the problem of how

to bring the surplus food of South America to the hungry mouths of Europe, may take a profitable lesson from these Lena elephants. Freeze the object to be preserved from decay in a block of ice; retain this in a frozen state and the entrance of the dreaded agents of change is at once barred. The conditions of permanent preservation are obtained; air is excluded; that which is within the substance is locked with the water and can act no farther. These are the simple conditions which have kept the Lena elephants unchanged, while the very vegetation which supported them has been swept away; and by observing these conditions we might have preserved the body of Cæsar himself unchanged to the present day. Who knows but that following the simple method here indicated, the forms of the illustrious dead may yet be preserved from generation to generation, giving a tangible chain to connect the too forgetful present with the past. What could so preserve the memory of a time as one of its chief actors sleeping before our eyes cased in crystal ice? Would not the world be richer if we could have before us the earthly habitations of a Dante, a Shakspeare, or an Humboldt, as they were left by their immortal selves? He who entered the cold depositaries of such precious relics could not come forth without feeling that he was closer wedded to a distant past than ever before. The author does not feel free to advise this Siberian treatment of our ancestors, as he is not sure but death should be followed by decay; but to those who think that the closer our relation to the past the better fitted we are for the work of the present, it must commend itself.

But to return to our elephants. The peculiar interest which is attached to the discovery of the well preserved remains of the only one of these animals which has come under the eye of a naturalist, warrants the transcription of the whole statement of the circumstances of its discovery.

This important discovery was made by the Chief Schumachoff, of the wandering tribe of Tunguzes, near the mouth

of the river Lena. The following account is translated and condensed from the description published in the "Memoirs of the St. Petersburg Academy of Sciences."*

"In 1799 he built a cabin for his wife on the borders of the Lake Oncoul, and then went to search on the shore of the northern sea, hoping to find some elephants tusks. One day he perceived in the midst of the ice cliffs a shapeless mass, which did not look like the heaps of drift wood which are often found there. In order to examine it more nearly, he came ashore and observed the object on all sides, but could not recognize what it was.

The following year he discovered at this point a sea cow, and saw at the same time that the mass which he had seen before was farther separated from the ice, and showed two long projections, but he could not yet determine what it was. Towards the close of the following summer the whole side of the animal and one of the tusks projected beyond the ice wall of the cliff. On his return to the shores of Lake Oncoul he communicated the result of this discovery to his wife and to some of his friends; but their way of looking at the matter gave him much distress. The old men told him that they had heard their fathers say that once before a similar monster had shown itself on the same peninsula, and that the discoverer and all his family perished soon afterwards. The mammoth was consequently looked upon as an augury of a dire calamity, and the Chief was so much affected that he fell very ill; but at last, being a little convalescent, his first idea was of the profits he might gain by selling the tusks, which were of extraordinary beauty and size. He gave orders to have the locality carefully concealed, and all strangers turned away on some pretext, charging at the same time some of his people to watch carefully that no one should steal his treasure.

But the summer was less warm than the preceding, and the mammoth remained buried in the ice which scarcely melted at all. At last, towards the close of the fifth year, the ardent desires of Schumachoff were happily accomplished. For that part of the ice which was between the ground and the mammoth having melted more rapidly than the rest, the surface became sloping, and this enormous mass, pushed by its own weight, slid down and sorted on a bank of sand upon the shore.

In the month of March, Schumachoff came to his mammoth, and having cut off his tusks sold them to a merchant for goods worth fifty roubles.

Two years afterwards, consequently soon after the discovery of the mammoth, and fortunately in travelling through this country I was able to establish these facts which one would have believed so improbable. I found the mammoth still in the same place, but entirely mutilated. The Jacutes of the neighborhood had cut up the flesh and fed it to their dogs during a period of scarcity, and the wild animals, white bears, wolves,

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*De Skeleto Mamonteo Siberico ad maris glaciales littora anno 1797 efosso, Auctore Tilesio. Mem. Acad. Imp., St. Petersburg. Tome v.

gluttons and foxes had picked the bones. The skeleton, almost entirely stripped of the flesh, was still entire with the exception of one forefoot. The spine from the head to the coccyx, a shoulder blade, the pelvis and the remains of the three extremities were still attached by cartilage. The head was covered with a dry skin. One of the ears was very well preserved, and furnished with a tuft of hair. All these parts have naturally suffered by transportation for a distance of eleven thousand werst. Still the eyes have been preserved, and in the left the ball is still visible. The brain remained in the skull, but seemed somewhat dried. The parts the least injured are one front and one hind foot; they were covered with hair, and had still the soles. According to the assertion of the Chief the creature was so fat that the belly hung down to below the knees. *The neck bore a long mane.* The skin, of which I collected about three-quarters, is of a dark gray color, covered with wool and black hair.

The escarpment from which the mammoth had slid had a height of from two hundred to two hundred and fifty feet, and is composed of clear, pure ice. It slopes towards the sea and its summit is covered with a coating of moss and friable earth about eight inches thick. During the heat of summer a part of the crust melts, but the rest remains frozen. Curiosity caused me to climb two other hills somewhat away from the shore. They were composed of ice also, and less covered with moss. At various points one saw fragments of wood of great size, and many tusks of mammoths imbedded in the ice precipices."

The peculiarities of the geographical distribution of organic life makes us associate certain animals and plants with certain features of climate. So that the inference was naturally made that the remains of elephants and rhinoceroses indicated a climate of a tropical character in the region where they are found at a time when these extinct species were living. That this is entirely fallacious is sufficiently proven by the fact that our Lena elephant is fitted to resist just such a temperature as now prevails in the regions where his remains are found. The hairy envelop afforded a non-conductor such as does not exist on the skin of any living animal outside of the Arctic circle. In place of the imperfect hairy covering of hairy pachyderms, or the bare skin of his living congeners, this elephant was provided with three distinct suits of hair and wool, the longest bristle-like hairs having various lengths up to a foot and a half, and serving the ruder purposes of defence; the next and shorter coat was a close set, tolerably fine hair, three or four inches long; within

this, in itself a considerable protection against the weather, lay a coating of wool, fitting the intervals between the other hairs, and enabling the animal to withstand the greatest rigor of the climate, which now prevails in this part of Asia. Acute observation has supplied us with another evidence of the fitness of this elephant to live in the ordinary conditions of high latitudes. In the tooth of the specimen, before described, was found a morsel of wood, the remains of the last meal made by the creature; the microscope of the botanist showed this fragment to belong to a coniferous tree, so that the stunted furs of the high north might have supplied food for herds of these mammoths. It is not, however, quite certain that these animals ever came down to the borders of the northern sea, though, as we have seen, they were fitted for such a climate as now prevails there; so far as we know the remains which are found around the mouths of the great rivers of Siberia are always in a position, which seems to indicate that they have been swept into their places by the river, and may thus have come from any point on its course. The fact that spring overtakes the stream at its headwaters, filling its channel with the floods of the annual melting, while the region near the estuary may be still frozen solid, renders these Siberian rivers, as all other streams which flow towards higher latitudes, peculiarly liable to destructive overflows. Overtaken by these inundations these clumsy inhabitants of this region were swept down towards the sea and stranded on the perpetually frozen soil of the shore; here buried in the mud and ice they soon became frozen, and each successive inundation thickened the sheet of ice and frozen soil which sealed them from decay. Nothing but a change of climate or an alteration in the course of the stream in such fashion as to disinter the remains can ever disclose the innumerable bodies of these ancient monsters which lie stark and stiff along the waters of that frozen sea. When the frequent disinterment of these valuable fossils, by the falling of the frozen cliffs of the rivers of Siberia,

are more closely watched, we will doubtless obtain similarly preserved bodies of the other large mammals which were contemporaneous with these elephants. It would be contrary to all analogy to find that these great pachyderms held these vast steppes of Siberia unassociated with other large mammals. We may reasonably expect to find a whole fauna of creatures fitted to the rude conditions to which we have seen this elephant is adapted.

Unfortunately we know too little concerning the fossils of the extreme northern part of North America to be able to say whether the Siberian elephants were peculiar to the Asiatic border of the Arctic Ocean, or extended over the northern part of this continent. All analogy in the distribution of life around that sea, at the present day, would lead us to expect that the same, or allied species, ranged all along our northern shore. The Mackenzie River being subject to just such a peculiar overflow as has embedded the elephants of Siberia in ice, we can hope that when its shores are better known there will be similar fossils found there. There seems to have been an obscure tradition among some portions of the Indians of eastern North America, that on the unexplored and distant recesses north of Lake Ontario and the St. Lawrence, there dwelt some great mammals which had a size like that of the elephant. With the early voyagers this was accepted as proof that the mammoth still lived in the western part of Labrador; and on some of the first maps this territory was laid down as the habitation of these surviving members of the giant race whose bones strewed the surface of so large a portion of the continent. It is to be expected that the Indians, who must from time to time have encountered skeletons of the mastodon and elephant where they had been unearthed by the changes of river courses, or brought to light in their efforts to free the obstructed course of large springs, such as those at Saratoga or Big Bone Lick, would have believed the species still living, and have assigned it a home in some distant region. A savage conceives with

difficulty the extinction of any species of large animal, but if it fails to cross his path is disposed to assign it a home in the region least known to him.

So far as is known to the author no remains, either of elephants or mastodons, have been found north of the parallel of forty-eight degrees east of the Rocky Mountains. South of this line the remains are found in tolerable abundance over the whole surface of the eastern United States as far south as middle Alabama. We have not sufficient evidence of the distribution of the remains of these animals to determine just what range they had. New England has given us the fewest remains, only rare traces of the presence of this species having been found. In the valley of the Hudson they are tolerably abundant. In New Jersey, where the conditions favorable for their preservation are frequently found, some of the most perfect skeletons have been disinterred. All over the middle states we come across traces of this species; and in the West, they are the most abundant of mammal remains. On the Pacific coast, the fossil elephants were as numerous as in the Mississippi Valley; on this side of the continent they seem to have a greater northern range. The explorations of Mr. Dall revealed the existence of these remains as far north as Alaska; so that on the west coast at least, we have the remains of American elephants as far north as those of Siberia. The existence of these remains in Alaska makes it exceedingly probable that we shall find the similar fossils throughout British America, and that our mammoth is specifically identical with that of Asia. It is remarkable that the buffalo, which once ranged far east, and covered the whole of the plain region of the Ohio basin with innumerable herds, has not left as many traces of his presence as the elephants. The remains of the mastodon seem even more plentiful than those of the red deer. Something must, no doubt, be attributed to the greater size and solidity of the bones of these pachyderms over those of bison and deer. Still the remarkable abundance of the elephant re-

mains is indubitable proof, not so much perhaps of the abundance of the individuals at any one time, as of the long continuance of the species on the soil. The buffalo was a temporary race on the Ohio Valley; he had probably been here only a few thousand years at most, possibly but a few hundreds, when the coming of the white man drove him beyond the Mississippi. He was not there at the time of the mound builders. His bones are not found among their remains. His striking form is not copied in their pottery, as are those of all other remarkable mammals of the valley. Nor do we find him delineated in the great figure mounds of the north-west; although if he existed in the region at the time when these people made these earthern monuments, he would have been sure of a prominent place among them. The elephants and mastodons, on the other hand, had a life which may possibly be reckoned by hundreds of thousands of years. A species was probably here before the glacial period; and since that time up to about the coming of man, possibly after his advent on the continent, they were continually present. The consequence is that their remains are found in about every spot where the conditions of their preservation exist. Almost any swampy bit of ground in Ohio or Kentucky where these huge creatures would have gotten mired in their efforts to get to water in dry seasons, or where the too yielding mud could have swallowed them up when they endeavored to cool themselves by wallowing in the mire, as is the habit of all elephants, contains more or less evidence of the presence of these animals. Sometimes a single tooth or tusk only has survived decay; at other times many skeletons are packed together in the bog. The numerous salt springs of the West, commonly called licks, are peculiarly rich in these remains. Like many other mammals these elephants were in the habit of seeking once a year, or oftener, some place where they could supply the hunger for salt. The saline waters, such as pour from Big Bone Lick, the upper and lower Blue Licks of Kentucky,

or other similar localities in the West, supplied this need, and here came, on an annual pilgrimage, all the large animals of the country. When this region was first occupied by the whites the bones of elephants and mastodons were found in abundance upon the surface, or buried beneath a thin covering of mould around the various springs of the first of these localities. For nearly half a century they supplied every strolling curiosity hunter with relics, besides furnishing the remarkably perfect specimen in the British Museum, as well as half a dozen less complete skeletons. There remain to this day traces of the ancient paths on which at the time the country was settled the deer and buffalo thronged to their favorite watering place. These traces, broader than a wide bridle path and worn to the depth of several feet, were fifty years ago the natural roads, leading from great distances, down to the springs. The buffalo evidently fell into the paths made by their predecessors, the elephants; for along the courses of these paths the mammoth remains seem most abundant. Although some of the remains of the *Elephas primigenius* give evidences of extreme antiquity, others seem comparatively very recent. The author has a tooth of this species which came from the uppermost terrace of the alluvial plain opposite Cincinnati, at a point over sixty feet from the surface. This tooth could not have been placed in its position less than fifty thousand years ago. Since the deposition of the beds where it lay the Ohio has deepened its rock channel over fifty feet, and shrunk to the mere shadow of the mighty stream which flowed through its valley when it bore the melting ice of the drift period. On the other hand some of the remains of the same species, such as those which lie upon the surface at Big Bone Lick, are so well preserved as to seem not much more ancient than the buffalo bones which are found above them. There is a great difficulty in determining the relative antiquity of the two elephants which have existed in the United States since the glacial period. The *Elephas primigenius* (if the species

be identical with the European representatives) seems on the whole to be more ancient than the *Mastodon Ohioticus*. It was beyond all question in existence when the upper terraces of our river bottoms were being formed, which must have been just as the ice sheet was passing away from the Alleghanies and was flooding our Western streams with its waters. This mastodon on the other hand seems never to be found under circumstances which indicate such great antiquity; it seems to have come in after the details of the river courses were about complete and all the terraces formed. There can be no doubt, however, that these two giants were associated during the latter part of their history. Although it is quite unusual for two allied animals of very great size to exist together in the same field, there is no reason why the Western world could not have been broad enough for both. There is sufficient difference in the structural features of these two races to warrant the supposition that they must have been characterized by considerable difference of habit and instinct such as would lead them to choose different fields of activity. It seems not unlikely, though the evidence is hardly sufficient to support the assertion, that the mastodon was most given to wandering in the swamps, while the elephant ranged on higher grounds.

The *Elephas primigenius*, or mammoth, was considerably taller than the Indian elephants of to-day, though not much exceeding them in length. The most striking differences of form were to be found about the head, which was considerably higher and more pointed than that of the Indian elephant, and provided with tusks, which instead of projecting downward and forward, curved quite abruptly outward and backward. The size of these tusks far exceeds those of any living elephant the author has measured; tusks of our North American mammoths have been found having a length on the outside of the curve of over ten feet, yet wanting both tips and bases. The perfect tusk must have been over eleven feet long. In

addition to the greater length of the tusks the mammoth was distinguished from the elephants of to-day by the long hair which hung in a coarse mane from the neck and along the belly, nearly dragging on the ground. This shaggy envelope of hair must have added greatly to the apparent size and formidable appearance of this giant.

We know less about the appearance of the mastodon than the elephant proper. Their proportions were evidently not more widely different than those of our domesticated bull and the buffalo. The mastodons were probably never over eleven feet high. They had straight tusks, as have our modern elephants, their grinding teeth, which exhibit the most characteristic differences, separating them from their larger relatives, were fitted for the grinding of rougher food. From the extreme frequency of the occurrence of the remains of the mastodon in the swamps of the West, it seems likely that this form of elephant was peculiarly suited to exist in such regions.

There can be no doubt that a few thousand years ago these companion giants roamed through the forests and along the streams of the Mississippi Valley. They fed upon a vegetation not materially different from that now existing there. Replace them in the primeval forests of that region and their wants would be as well supplied as when they were lords of the domain. The fragments of wood which one finds beneath their bones seem to be of the common species of existing trees; even the reeds and other swamp plants which are imbedded with their remains are apparently the same as those which now spring in the soil. The naturalist, accustomed as he is to behold the mysterious changes of life, where races sink at once into a common grave, and the face of earth prepared for other actors in the great tragedy of existence, cannot but feel more keenly than before the temporary character of all life when he opens to the light of day the resting place of one of those species of gigantic animals. What could have been the nature of these agents

which at one stroke drove from the face of earth two of the most powerful races of its inhabitants, sweeping with them many smaller forms, such as the extinct deer and bulls which we find buried with them. The unchanged geography of the country assures us that no great convulsion of nature brought it about. The similarity of the vegetation of the elephant period, with that now growing on the same soil, shows pretty conclusively that it was not due to great geographical changes of other regions reacting on the climate of the region they inhabited. It is not meant to assert that no changes of climate have taken place; on the contrary, such changes have most likely come about; but they have hardly been sufficient to extinguish animals so well adapted as the *Elephas primigenius* undoubtedly was to brave climatic irregularities.* There seems but one other way to explain the extirpation of these races and that is through the action of man. There is no longer any doubt that our ancestors of the stone age, on the European continent, were ushered on to earth in the midst of the gigantic animals of the elephant period. It is now over thirty years since Schmerling of Liege presented the evidence of the contemporaneity of the remains of man with those of the cave bear and other extinct animals. Step by step the evidence has accumulated, overwhelming the determined opposition of those who think that the truth they have is necessarily damaged by all new discoveries. It is impossible to present here the evidence which supports what may seem to many a too confident assertion; its character is known to most readers. Bones of these extinct animals, split for marrow and worked for tools, are probably the most important part of the evidence. But the most unquestionable bit of proof is that which is furnished by a fragment of a tusk of an elephant in the collec-

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* So far from a change from warmth to cold having been the cause of the extinction of the fossil elephants which have recently disappeared from the Mississippi Valley, all the evidence would warrant the conclusion that if change of climate was the agent at all, it likely acted by an alteration from cold to warmth, giving a climate too hot for a creature probably clothed as we know the Lena elephant to have been.

tion of M. Lartet, of Paris. Some artistic spirit of the stone age has commemorated an incident of the chase by graving upon this fragment a rude, but spirited representation of the animal to whom the tusk belonged. The form is very characteristic; the shape of head, such as the species is known to have had, differing considerably from that of the African elephant, is clearly shown. But one feature alone is sufficient to show that the savage meant to represent a member of the race to which the Lena elephant belonged; it is the long, shaggy hair, falling like a mane from the shoulders and neck and fringing the belly; this is clearly indicated in the engraving. But for the preservation of the Siberian elephants in ice we would have failed to perceive the meaning of this feature in the drawing; as it is it leaves no doubt that he who drew it had an *Elephas primigenius* in his mind's eye.

It was probably for the best that man should have come upon earth while these giants still lived. They were his teachers in the first arts of craft and courage. Having to dispute the possession of his primitive home, the caverns, with the gigantic cave bear, and the mastery of the forests with the formidable elephants, he was compelled to contrive weapons and use them with well concerted bravery. The magnitude of the dangers which surrounded him compelled him to associate himself with his fellow men, and his triumphs in struggles, where skill and valor prevailed against animal strength, gave him the first rude education of the combat.

If we must seek a reason for the death of the elephants in external influences we may well find it in the coming of man, though it would be quite as reasonable to suppose that their race already, as we have seen very ancient, passed away because it had lived its time and done its appointed work. We have no such evidence of the contact of man with this ancient race of giants on the continent of North America as European discoveries have afforded. No one who has ex-

amined the conditions of entombment of the extinct peoples of the Western states, the preservations of their remains, and the changes which have taken place since their deposition, can believe that the disappearance of the elephants, and the coming of the North American man were separated by any great length of time. When the fields of the West, rich in the remains of these ancient animals and ancient men, are studied as they will be by the rising generation of investigators of that region, the precise relation will be easily established. It is not likely that it will be found that the highly organized mound building nations were instrumental in driving the extinct elephants from the soil of North America. Had they come in contact with these large creatures we should have had some representation of them in their pottery sculpture, where we find figures of all the common large mammals of the West, except as before remarked, the bison, as well as other forms like the manatee which could not have been personally known to the inhabitants of the Ohio Valley. It is more likely to have been some rude dweller in caves of the stone age who slew the last mammoth of America.

The history of the changes in the elephant life, a little while ago so abundant, on three at least of the five continents, is not unlike what we find among other types of animals and plants which have passed the full meridian of their existence and are hastening to their setting. While the type is in its full vigor it spreads its diversified species far and wide over northern as well as southern lands; when it begins to wane the northern species fall first in the struggle, and the last remnants of the type are found beneath the torrid sun where easier conditions permit them to protract a senile life. Among the plants the palm and tree ferns; among the animals the large reptiles like the crocodiles and alligators, the rhinoceros, the hippotamus, the tapirs, the monkeys, and many other types find in the tropical forests the conditions of existence which the ruder climes of the north long since

denied them. Our speculative friend asks, "may it not be that man, driven from the northern lands by the coming of his higher successor on the stage of life, is to finally end his race on earth within the recesses of the gloomy forests of Brazil or Borneo?"

THE MOLLUSKS OF OUR CELLARS.

BY W. G. BINNEY.

MOST of the readers of the NATURALIST, who reside in the cities of our Atlantic coast, are aware that the cellars of their houses are infested with slugs and snails. They have seen or heard of the glistening tracks made by their slime, and have heard dreadful stories of the ugly creatures who left them when escaping from their nocturnal depredations. But as few of our readers have met them face to face, we propose giving a short description of each with a portrait of sufficient accuracy to enable any one to identify the separate species.

A word first about their characters and habits. They all belong to the great division of mollusks which are called *Pulmonata*, from the fact of their breathing with lung-like vessels. Furthermore, they all belong to that group of *Pulmonata* which are called *Geophila*, or lovers of dry land, from the fact of their habits being terrestrial in distinction from those which are adapted to living in fresh-water, or in the sea. These *Geophila* are distinguished in addition to their breathing with lung-like vessels by their having their eyes at the end of long, slender, cylindrical feelers. Thus far most authors agree, but in subdividing these *Geophila* into natural groups there is so little accord among naturalists that we do not carry our readers farther in classification. Suffice it to say that literally from head to tail almost every

character has been seized to found families upon, and thus far the conchological world is but little the wiser for it.

Our cellar mollusks are all nocturnal in their habits. They lie quietly stowed away in some crack or crevice of the walls during the day. At night they sally forth in pursuit of food and to enjoy the company of their kind. They feed on vegetable matter—refuse from the kitchen, decaying vegetables or fruits—or on Indian meal, flour, or anything they are lucky enough to find. They even devour animal food, and in confinement have even been accused of cannabalism. When one comes to know how well adapted their mouth is to eating, it becomes a wonder that our mollusks leave anything uneaten. For the mouth of each individual mollusk is

Fig. 42.

Jaw of *Limax flavus*.

Fig. 43.

Half row of teeth of *Limax flavus*.

armed at its entrance with a sharp, stout, pointed process, called a jaw, for want of a better term. This falls, portcullis-like, on the food of the animal, and cuts off pieces into his mouth. We give here a figure of the jaw of *Limax flavus* one of the species mentioned below (Fig. 42). Once in the mouth the food is taken hold of by a long, broad, ribbon-like membrane, generally called a tongue. The whole surface of this tongue is covered with sharp, tooth-like processes running in transverse rows. These small, sharp teeth rasp quickly the food and carry it forwards towards the stomach. Short work they must make of it, for the number of these tooth-like processes is very great, counting as high as eighty thousand in some species. We give here a figure of one-half of one transverse row of teeth on the tongue of the same species whose so-called jaw is already figured (Fig. 43). To

understand the figure it must be borne in mind that the remaining half of this transverse row is similar to the half figured, and that all the transverse rows are alike. Thus our figure gives as good an idea of the tongue as if the whole hundred rows of eighty-five teeth each were given. No wonder the possessors of all these teeth have a reputation for voracity and that their presence is dreaded in kitchen gardens.

Our cellar mollusks are active all the year round, owing to the milder and more equal climate of their abode. They do not hibernate like their brethren of the fields and woods. Their soft shell-less body gives them little protection from their enemies. Like all animals so defenceless they would soon become exterminated had they not great powers of reproduction. They lay eggs several times during the year, and in such numbers that a couple of them will lay as many as six hundred in a year. These eggs are gelatinous, semitransparent and globular, sometimes attached together like a rosary. They are remarkably tenacious of vitality, so much so that they resist the greatest extremes of temperature. They have even been shrunk and dried in a furnace and kept for years in this state, yet still have developed their young upon being restored to moisture. The young animal emerges from the egg in about a month, and when two months old begins to reproduce its kind, though not itself arrived at more than half its greatest size.

Only one species of our cellar mollusks is furnished with an external well developed shell. The others are what are commonly known as *slugs*. They have, however, under the skin of the forepart of their body, called the mantle, a rudimentary shell, either in grains of calcareous matter or in a regular calcareous plate. This plate was formerly supposed to have great medicinal properties, and has been said to be a sovereign remedy for almost all the ills that flesh is heir to.

The whole surface of their body is constantly lubricated by a watery fluid. They also have the power of secreting a

milk-like mucus at any part of their body which may require protection from any foreign substance. This secretion of mucus is their only means of defence against their enemies. It also is used as a thread like the spider's web to enable them to descend to the earth.

All the species mentioned below are of foreign origin. They were imported from England. They are found only in close proximity to man around his habitation, either in cellars or gardens. Most of them were noticed more than half a century ago, as early as mollusks became to be studied in our country. They have also been imported into other colonies of England, and probably are destined to become the most cosmopolitan of mollusks.

Fig. 44.

Shell of *Hyalina cellaria.*

We will now describe the various species found in our cellars, commencing with the only one which bears a well developed external shell (Fig. 44). This is the *Hyalina cellaria*, a thin, horn colored, glistening, flattened shell of five whorls, and less than half an inch in diameter. The edge of the aperture is sharp, not reflected, or thickened by a border of testaceous matter. It is a common European shell of which a single specimen was first noticed by a gentleman in Philadelphia on a wharf near the foreign shipping. It was shown to Mr. Say, who described it as a new species. Of late years it has not been seen in that city, but from Astoria, Long Island, to Halifax, it exists in almost every Atlantic port. It is found only in cellars and gardens. It used to be very common under the bricks of the inner edge of the sidewalk on the north side of Mount Vernon street, Boston, between Walnut street and Louisberg Square.

Fig. 44*a*.

Animal of *Hyalina cellaria.*

Limax maximus is the largest of our cellar slugs (Fig. 45). It seems to be a more recent importation than the other species, having first been noticed in Philadelphia in 1867. It appeared almost simultaneously at Brooklyn, New York, and

at Newport, R. I. The individual figured was found in a garden in Pelham street of the last named city. Some indi-

Fig. 45.

Limax maximus.

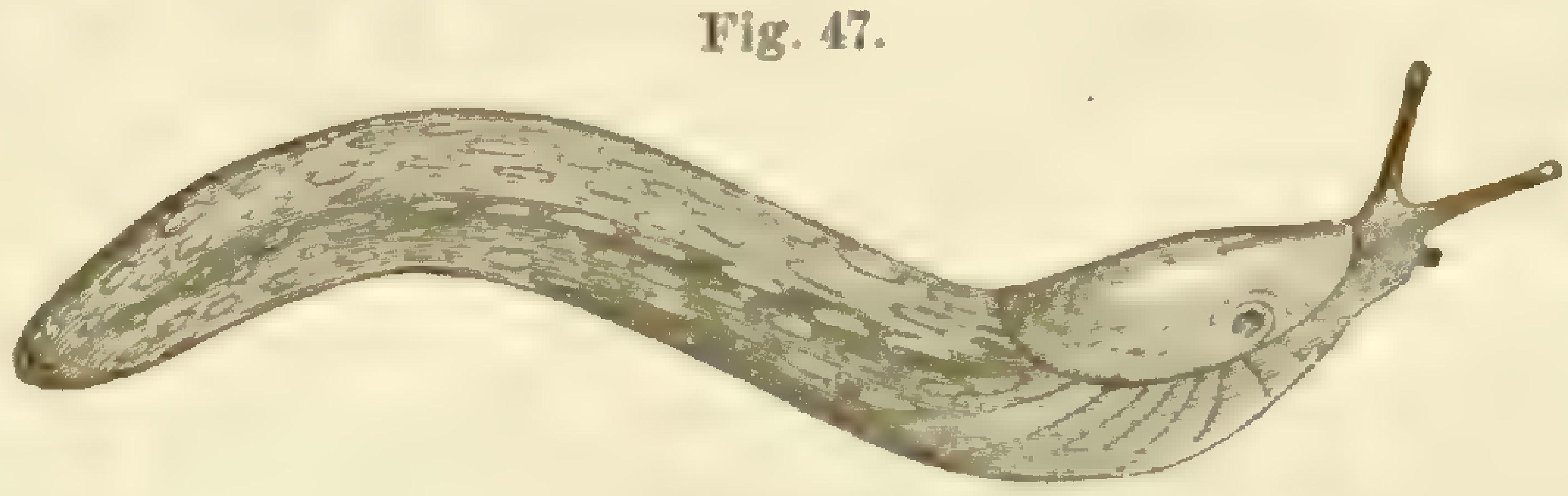
viduals placed in a garden in Burlington, New Jersey, were shortly after found in an adjoining cellar. This species is readily distinguished by the rich brown or black stripes running lengthwise down its back, giving it a leopard-like appearance. It is about four inches long.

Fig. 46.

Limax flavus.

Limax flavus, whose tongue and jaw are figured above, grows about three inches long (Fig. 46). It is characterized by a brownish color, with oblong-oval uncolored spots; body cylindrical, elongated, terminating in a short prominent keel; mantle oval, rounded at both ends, with rounded spots; base of foot sallow white. It has been noticed for more than forty years in the cities of our Atlantic coast, and probably has followed the white man over the whole country.

Fig. 47.



Arion fuscus.

Arion fuscus belongs to a different genus from the last named slugs (Fig. 47). It is readily distinguished by its

jaw which has no median beak-like projection to its cutting edge, but has rib-like processes on its anterior face, crenulating the margin. Its tongue differs also in the form of the teeth. In the forepart of its body, under the rounded shield-like process of the skin, there are calcareous grains instead of a well formed plate. And finally at its tail is a decided triangular perpendicular mucus pore. It grows about one inch long. The color is whitish, grayish or brownish; upper surface marked with elongated crowded glands; mantle oval, granulated; tail obtuse, not carinated; the sides marked with an obscure brownish line. It is of European origin and thus far has only been noticed in Boston and vicinity. It is not properly a cellar snail, but is found with the preceding species around kitchens and gardens.

REVIEWS.

CHALCHIHUITLS.* — [Mr. Squier has in this communication to the Lyceum given a very important and interesting summary of what is known relating to the carved "green stones" from Mexico and Central America, and as he has kindly placed the original cuts of the article in our hands, we make this review in the form of extracts from his communication. In a future number we shall give figures of a few similar carved stones collected by Mr. McNiel in Nicaragua.]

"Among the articles of ornament used by the aboriginal inhabitants of Mexico and Central America, those worked from some variety of green stone resembling emerald, and called by the Nahuatl or Mexican name *chalchiuitl*, *chalchihuitl*, or *chalchiuite*,† were most highly esteemed, and are oftenest mentioned by the early explorers and chroniclers. The word *chalchiuitl* is defined by Molina, in his *Vocabulario Mexicano* (1571), to signify *esmeralda baja*, or an inferior kind of emerald. The precious emerald, or emerald proper, was called *quetzalitztli*, from the *quetzal*, the bird known to science as the *Trogon resplendens* (the splendid plumes of which, of brilliant metallic green were worn by the kings of Mexico and

* Observations on a Collection of Chalchihuitls from Mexico and Central America. By E. G. Squier. From the Annals of the Lyceum of Natural History of New York. 1869.

† I have followed the orthography of the word throughout, as given by the various authors quoted.

Central America as regal insignia), and *itzli*, stone; *i.e.* the stone of the *quetzal*.

Sahagun mentions four of the Mexican gods who were the especial patrons of the lapidaries, and honored as the inventors of the art 'of working stones and *chalchiuites*, and of drilling and polishing them.' He does not, however, describe the process made use of by the Indians in cutting precious stones, 'because,' he says, 'it is so common and well understood;' an omission which his editor, Bustamente, regrets, 'since the art is now entirely lost.'

Quetzalcoatl, the lawgiver, high-priest, and instructor of the Mexicans in the arts, is said to have taught not only the working of metals, but 'particularly the art of cutting precious stones, such as *chalchiuites*, which are green stones, much esteemed, and of great value.' (*Torquemada*, lib. vi., cap. xxiv.) Quetzalcoatl himself, according to certain traditions, was begotten by one of these stones, which the goddess *Chimalma* had placed in her bosom. Indeed, both among the Mexicans and the nations farther to the southward, the *chalchihuitl* seems to have represented everything that was excellent in its kind. Its name was used in compounding designations of distinction and honor, and was applied both to heroes and divinities. The goddess of water bore the name of *Chalchiuitlcuye*, the women of the *chalchiuites*; and the name of *Chalchiuhapan* was often applied to the city of Tlaxcalla, from a beautiful fountain of water near it, the color of which, according to Torquemada, 'was between blue and green.' Cortez, according to the same authority, was often called '*Chalchiuitl*, which is the same as captain of great valor, because *chalchiuitl* is the color of emerald, and the emeralds are held in high estimation among the nations.' (*Monarchia Indiana*, vol. i, p. 435.) When a great dignitary died his corpse was richly decorated for burial with gold and plumes of feathers, and 'they put in his mouth a fine stone resembling emerald, which they call *chalchihuitl*, and which, they say, they place as a heart.' (*Ib.*, vol. ii. p. 521.)

Fig. 48.

Human Skull, Ancient Mexican, inlaid with turquoise and obsidian.

Sahagun, in one place describes the *chalchihuitl* as 'a *jasper* of very green color, or a common emerald.' Elsewhere he goes into a very full description of the various kinds of green stones which the Mexicans held in esteem, and as his account may materially aid in identifying the *chalchihuitl*, it is subjoined entire:

'The emerald which the Mexicans call *quetzalitztli* is precious, of great value, and is so called, because by the word *quetzalli* they mean to say a very green plume, and by *itztli*, flint. It is smooth, without spot; and these peculiarities belong to the good emerald; namely, it is deep green with a polished surface, without stain, transparent, and at the same time lustrous. There is another kind of stone which is called *quetzalchalchivitl*, so called because it is very green and resembles the *chalchivitl;* the best of these are of deep green, transparent, and without spot; those which are of inferior quality have veins and spots intermingled. The Mexicans work these stones into various shapes; some are round and pierced, others long, cylindrical, and pierced; others triangular, hexagonal or square. There are still other stones called *chalchivites*, which are green (but not transparent), mixed with white; they are much used by the chiefs, who wear them fastened to their wrists by cords, as a sign of rank. The lower orders (*macequales*) are not allowed to wear them. . . . There is yet another stone called *tlilaiotic*, a kind of *chalchuite*, in color black and green mixed. . . . And among the jaspers is a variety in color white mixed with green, and for this reason called *iztacchalchiuitl*.* Another variety has veins of clear

Fig. 49.

Chalchihuitl, or engraved precious stone, from Ocosingo, Central America. Full size.

* *Iztac* signifies white; i. e. *white chalchihuitl.*

green or blue, with other colors interspersed with the white. . . . And there is yet another kind of green stone which resembles the *chalchiuities*, and called *xoxouhquitecpatl*.* It is known to the lapidaries as *tecelic*, for the reason that it is very easy to work, and has spots of clear blue. The wrought and curious stones which the natives wear attached to their wrists, whether of crystal or other precious stones, they call *chopilotl*—a designation that is given to any stone curiously worked or very beautiful.' (*Historia de Nueva España*, lib. xi., cap. viii.) The same author, describing the ornaments which the Mexican lords used in their festivals, speaks of a 'head-dress called *quetzalalpitoai*, consisting of two tassels of rich plumes, set in gold, and worn suspended from the hair at the crown of the head, and hanging down on each side towards the shoulders. They also wear rings of gold around the arms and in their ears, and round their wrists a broad band of black leather, and suspended to this a large bead of *chalchiuitl* or other precious stone. They also wear a chin ornament (*barbote*) of *chalchiuitl* set in gold, fixed in the beard. Some of these *barbotes* are large crystals, with blue feathers put in them, which give them the appearance of sapphires. There are many other varieties of precious stones which they use for *barbotes*. They have their lower lips slit, and wear these ornaments in the openings, where they appear as if coming out of the flesh; and they wear in the same way semilunes of gold. The noses of the great lords are also pierced, and in the openings they wear fine turquoises or other precious stones, one on each side. They wear strings of precious stones around their necks, sustaining a gold medal set round with pearls, and having in its centre a smooth precious stone.' (*Ib.*, lib. viii. cap. ix.)

In these descriptions, it will be seen that the *chalchihuitls* are spoken of as ornaments, round or oblong beads, which conforms with the representations in the paintings. But these or similar green stones were used for other purposes. The chronicler Villagutierre, in his account of the conquest of the Itzaes of Yucatan, speaks of idols in their temples 'of precious jasper, green, red, and of other colors;' and, in describing the great temple of Tayasal, mentions particularly an idol which was found in it, 'a span long, of rough emerald (*esmeralda bruta*), which the infidels called the god of Battles,' and which the conquering general, Ursua, took as part of his share of the spoil.

The Mexicans nevertheless had true emeralds, of which we have left to us the most glowing descriptions. Gomara describes particularly five large ones which Cortez took with him from Mexico to Spain at the time of his first visit, and which were regarded as among the finest in the world. They were valued at 100,000 ducats, and for one of them the Genoese merchants offered 40,000 ducats, with the view of selling it to the Grand Turk. Cortez had also the emerald vases, which the padre Mariana assures us, in the supplement of his History of Spain, were worth 300,000 ducats. They are reported to have been lost at sea. All these emeralds

* From *xoxouhqui*, *cosa verde*, something green, and *tecpatl*, stone; *i. e.* green stone.

were cut in Mexico by Indian lapidaries under the orders of Cortez, and were most elaborately worked. One was wrought in the form of a little bell, with a fine pearl for a clapper, and had on its lip this inscription in Spanish, *Bendito quien te crió!* Blessed he who made thee! The one valued most highly was in the shape of a cup, with a foot of gold. All of them were presented by Cortez to his second wife, who thus, says Gomara, became possessed of finer jewels than any other woman in Spain. Remarkable as were these emeralds, Peter Martyr mentions one, of which Cortez was robbed by the French pirates, that must have surpassed any of them in size and value.

Fig. 50.

Basso-Relievo of the god Cuculcan, from Palenque.

Coming down to later times, we find Professor P. Blake (Amer. Jour. of Sci. and Arts, March, 1858), in an interesting article on 'The Chalchihuitil of the Mexicans,' informing us that the Navajo Indians in the northern and western portions of New Mexico wear small ornaments and trinkets of a hard, green stone, which they call by the Mexican name, and which they regard as of great value; 'a string of fragments large enough for an ear-ring being worth as much as a mule.' Mr. Blake, suspecting this stone to be turquoise, and learning that it was yet procured in small quantity by the Indians among the mountains about twenty miles from Santa Fè, visited the spot, where he found an immense pit excavated in granular porphyry, '200 feet in depth and 300 or more in width,' besides some smaller excavations. He obtained many fragments of the so-called *chalchihuitil* 'of applegreen and peagreen, passing into bluish-green, capable of a fine polish, and of a hardness

little less than that of feldspar.' The fragments found were small, not exceeding three-quarters of an inch in length and one-quarter of an inch in thickness, and the material 'appeared to have formed crusts upon the surfaces of cavities or fissures in the rock, or to have extended through it in veins.'

Mr. Blake's description applies to the specimens exhibited to the Lyceum not long ago by Professor Newberry, and there is no doubt that the material was, or rather is, a variety of the turquoise. But I doubt if it be the true *chalchihuitl* of the Mexicans and Central Americans. That they used the stone described by Mr. Blake for certain purposes, I know;

Fig. 51.

Chalchihuitl from Ocosingo. Two-thirds actual size.

for there exists in the museum of the late Mr. Henry Christy, in London, a human skull completely encrusted with a mosaic of precisely this stone, and a flint knife with its handle elaborately inlaid with it, in small fragments. Of the first of these relics I present a drawing made by Waldeck and published by the French Government. See FIG. 48.*

The weight of evidence, in my opinion, goes to show that the stone properly called *chalchihuitl* is that which Molina defines to be '*baja esmeralda*,' or possibly nephrite, 'a jasper of very green color,' as Sahagun, already quoted, avers. I should therefore object, on strictly critical and historical grounds, to the suggestion of Mr. Blake, that the variety of turquoise found by him should be 'known among mineralogists as *chalchihuitl*.'

But apart from any speculations on the subject, I have to lay before the Lyceum a most interesting series of green stones, unrivalled, in their

* In Mr. Christy's Museum is also a wooden mask encrusted in like manner, with turquoises, malachite, and white and red shells. The predominant stone in all is the turquoise. The back of the skull in the specimen engraved is cut away, so as to admit the face to be hung by leathern thongs (which still remain) over the face of an idol, as was the custom in Mexico. The transverse black bands in the cut are of obsidian in the original. The eyeballs are nodules of iron pyrites, cut hemispherically and highly polished.

way, in the world, which were found among the ruins of Ocosingo, in the department of Quesaltenango, Guatemala, on the borders of Chiapas, and not remote from the more famous but hardly less imposing monuments of Palenque. I must not omit to say that, in common with similar stones, they were designated by the people of the region where they were found as *chalchichuites*.

FIG. 49. — The first and most interesting of these is precisely four inches long by two and three-tenths broad, and about half an inch in average thickness. The face is sculptured in low relief, with the figure of a divinity seated, cross-legged, on a kind of carved seat, with his left hand resting on his thigh, and his right raised to his breast, as if in the act of giving benediction. Around his loins is an ornamental girdle, and depending from his neck and resting on his breast is an oblong rectangular plate or charm, not unlike that said to have been worn by the Jewish high-priests. The face is in profile, showing the salient nose and conventional receding forehead that characterize most Central American sculptures. Ornaments are inserted in the lobes of the ears, and the head is surmounted with the characteristic and elaborate plumed head-dress that we observe on the Palenque monuments and in the paintings. The whole is almost an exact miniature copy of the large *bas-relief* found by Mr. Stephens in an inner chamber of one of the ruined structures of Palenque (FIG. 50). At about one-third of the length of the carved chalchihuitl, measuring from the top, it is drilled through from edge to edge, the hole being a little less than two-tenths of an inch in diameter: the drilling having been made from each side to the centre, where the two drillings run one into the other, with a slightly diminished bore. The purpose of this seems to have been to suspend the object from the neck or other part of the person; but the back edges of the plate are also pierced diagonally, as if to afford means of fastening it to cloth or other material, without those means showing in front.

Fig. 52.

Chalchihuitl from Ocosingo. Two-thirds actual size.

FIG. 51. — The next relic in importance is of a similar but more opaque material, which, were it not for a strip of clear quartz on one edge, might be mistaken for enamel. It is a semi-disk in shape, four and a half inches in length by two and seven-tenths in greatest width. It shows a human face in full front, surmounted by a kind of heraldic shield, and surrounded by a profusion of feather ornaments, with huge ear-rings and other ornaments below the chin. It, too, is pierced near its upper edge, longitudinally from side to side. The back shows that it was sawn from a solid block of the same material, both from above and below, until the cuttings reached each other within half an inch, when the intermediate core, if I may so call it, was broken off. The *serræ* of the saw is distinctly visible from the top as well as the bottom, although the *striæ* are nearly polished out. This was clearly intended to be suspended, as there are no means by which to fasten it to robes of any kind. It must have served as a gorget or breast-plate.

FIG. 52.—This is a most interesting, although a very irregular, and comparatively rude specimen, four inches and two-tenths long by two and a half inches wide at its widest part. The back shows a compact greenish stone, with the same evidences of having been sawn from a solid block to which I have alluded in describing FIG. 51. The front appears as if of a brilliant green enamel, exhibiting a full human face with a large and elaborate feather helmet or crown, huge ear and neck ornaments impossible to describe, and only to be understood by inspection of the original. This, too, is pierced, like that last described, from edge to edge, near its upper end.

FIG. 53. — This is a comparatively small fragment of identical material with FIG. 49, an irreg-

ular triangle in shape, somewhat concave on the face, where is carved in profile a human head, surmounted also with elaborate plumes, but with eyes closed as if in death. This is drilled through vertically and horizontally, and there are small diagonal holes, designed to afford means of attachment by threads to some portion of the dress of the wearer. It is polished back and face, and measures two and three-tenths inches by one and nine-tenths. It has its almost exact counterpart in the Christy, formerly Mayer, Museum, of London.

Fig. 54.—This specimen is peculiar and very interesting. It is a slightly irregular globe, two and six-tenths inches in diameter, pierced from top to bottom by a perfectly circular hole one and three-tenths of an inch in diameter. On three sides, if I may use the expression in respect of a sphere, are as many engraved hieroglyphics, using that term in the popular sense, but which I conceive to be syllabo-phonetic or phono-syllabic signs, of which, of course, only engravings can give any adequate notion. (Figs. 55, 56, 57.) As I shall have something to say about this specimen farther on, I proceed to notice a simple polished perfect globe, of the same material with that last alluded to, and which may be sufficiently described as a large bead, an inch and a tenth in diameter, pierced through its exact centre by a hole sufficiently large to admit a stout thread.

Fig. 53.

Chalchihuitl from Ocosingo. Full size.

Figs. 58 and 59 are types of a large class of what may be called chalchihuitl ornaments, with no special significance.

Figs. 60 and 61, however, may have a hieroglyphical significance. The latter (Fig. 61) is a fragment of a thin plate, of the same stone with the objects already described, two inches and eight-tenths in length by two inches and three-tenths broad and two-tenths of an inch thick, engraved on both surfaces and cut through with ornamental devices.

Fig. 62 is an engraving of one of a number of hat-shaped objects of the stone under notice, pierced through, so as to leave a very thin rim and walls, and obviously designed to hold those *penachos* or clusters of feathers which the Spanish conquerors so often describe, and which are so conspicuous in the head ornaments represented on the monuments and in the aboriginal paintings of Mexico, Central America, and Peru. They are each two inches and two-tenths in diameter over the rim, one inch and one-tenth high, with a bore of eight-tenths of an inch in diameter.

Fig. 54.

Chalchihuitl globe, pierced. One-fourth size.

The relics above described are fair types of the chalchihuitls found at Ocosingo; but I possess some other worked and engraved greenstones, worth mentioning, perhaps, in this connection. The first of these,

Fig. 63, has some resemblance to the engraved Assyrian seals, or, as they are sometimes called, 'Chaldean' cylinders. It is a perforated cylindrical piece of heavy, opaque stone, of a dark sea-green color (nephrite?), two inches long by an inch and one-tenth in diameter. In a kind of oval or what Egyptian scholars would call a *cartouche*, is presented the profile of some divinity (the Maya God of Death?), with the eye closed and the tongue depending from the corner of the mouth. Something like claws, engraved on a projection of the cylinder, start out from the *cartouche* on the left side. The whole is boldly and sharply cut, and highly polished. This relic was obtained from the island of Flores, the ancient Tayasal, in the lake of Itza or Peten, in Yucatan. Among the things found by the conqueror of the Itzaes, Ursua, in the

temples which he destroyed in the island in 1697, he mentions 'an idol of emerald a span long, which,' says the chronicler, 'he appropriated to himself.'

It may be observed of the figure engraved on this stone, that *to speak*, among American nations, was the verbal as well as the symbolical expression of life or being, as is *to see* or *to*

Fig. 55.

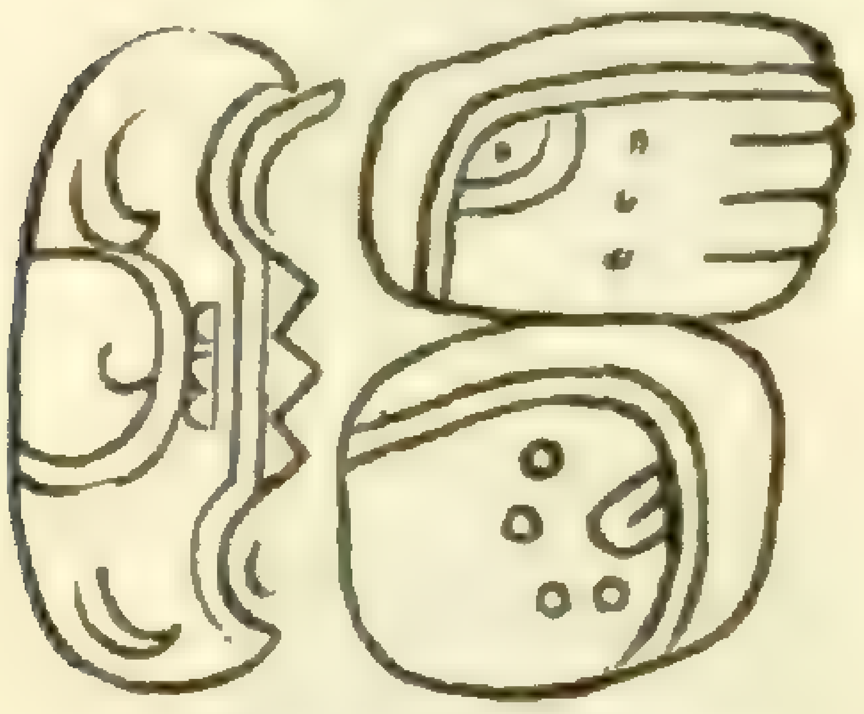


Fig. 56.

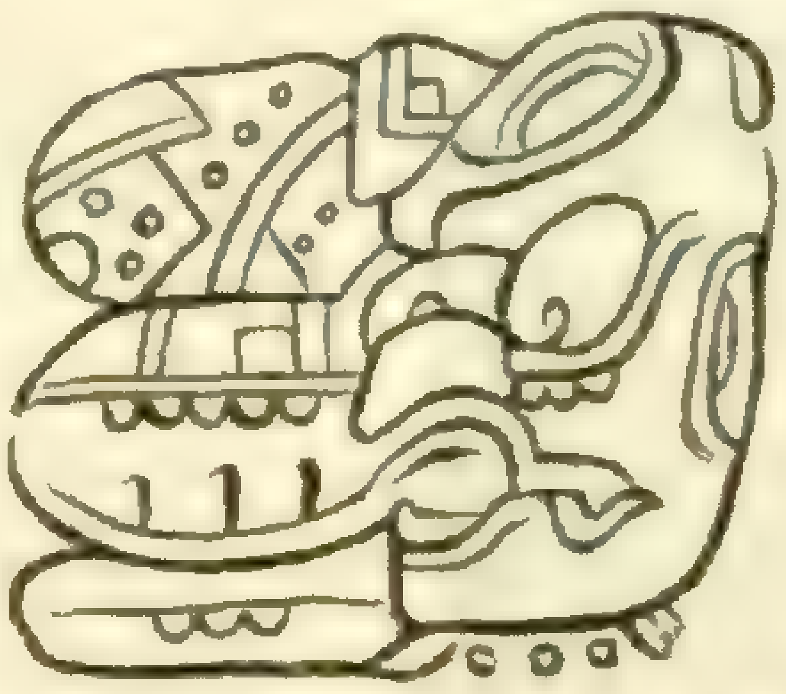
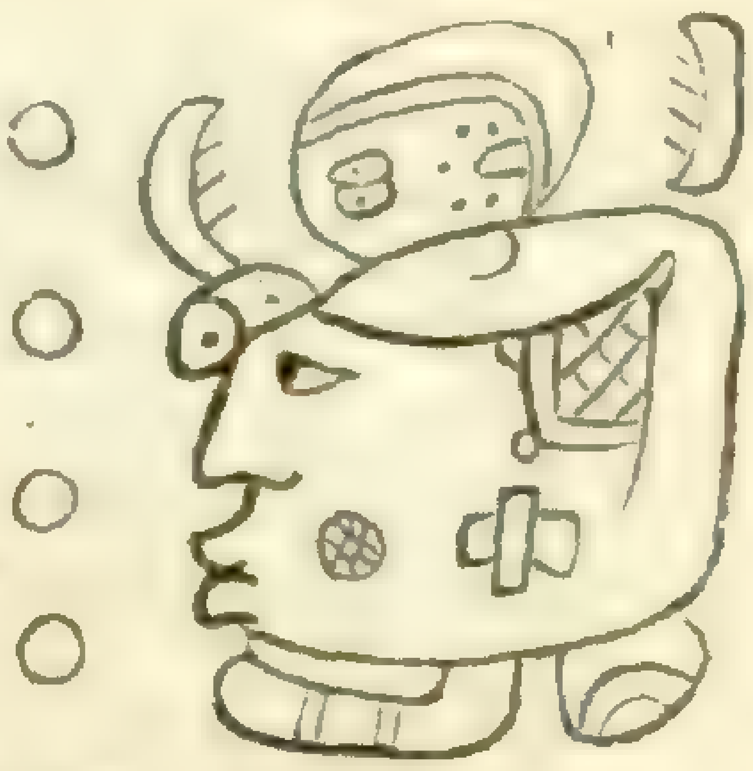


Fig. 57.



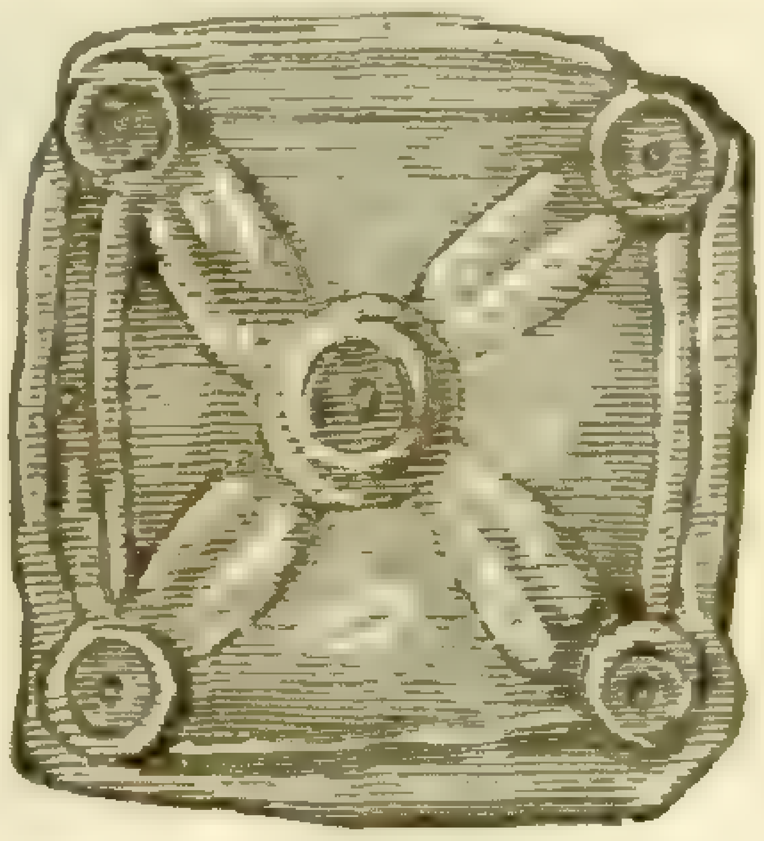
"Hieroglyphics" on Chalchihuitl globe. Full size.

breathe, or *to eat*, among other nations in various parts of the world. The projecting tongue in the sculptured and painted American idols and figures denotes the living God or man: he who can talk, and therefore lives. In this instance, the lax and drooping tongue heightens the idea of death which the closed eye in part conveys.

FIG. 64 is an engraving of a stone hatchet or adze of hard green stone, resembling quartz, five inches long. It is highly polished on the face, but the reverse has marks which show that it too was sawn from a block of the same material. Where the notches occur in the sides there are holes drilled entirely through the stone, parallel with its face. The lower or cutting edge is slightly curved outward, implying that, if intended for practical service, it was an adze. But it is to be presumed that it was worn symbolically, in the way of distinction or ornament. It was found in an ancient grave in Costa Rica. The ruling Inca of Peru carried an axe instead of a sceptre as one of his insignia of dominion.*

Fig. 58.

Fig. 59.



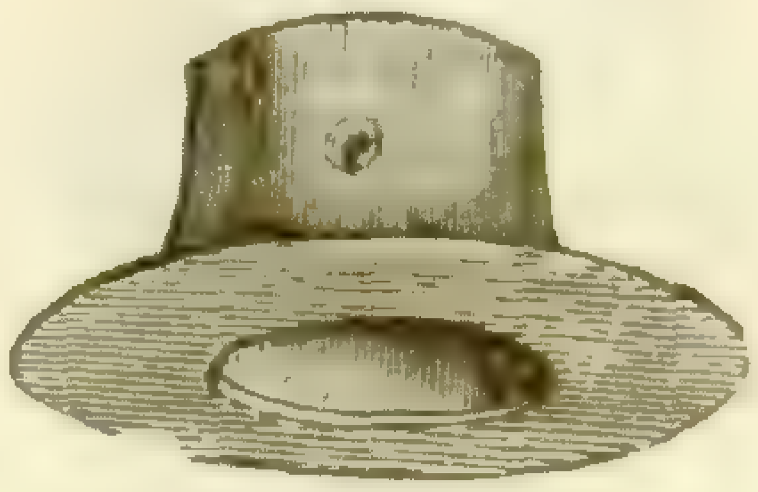
Chalchihuitl ornaments. Half size.

Fig. 60.

Fig. 61.

Chalchihuitl engraved plates.

Fig. 62.



* In Greece stone weapons of jade or nephrite are sometimes found, which the common people call 'thunderbolts,' and hold in high estimation. A correspondent of the 'London Athenæum' found a similar object, called by the same name, in Nassau, New Providence, in the Bahamas. He describes it as polished and flattened, pointed at one end, with a broad cutting edge at the other, and regarded by the natives as a preventive against lightning. Another correspondent of the same publication states that he found a similar object in Jamaica forty years ago, also called a thunderbolt. It was kept in an earthern jar filled with water, and was supposed to keep the water cool.

FIG. 65 (full size of original) is the easily recognizable figure of a frog, in a kind of malachite from the island of Omotepec, Lake Nicaragua.

FIG. 66 is of still another and harder variety of green stone, from a mound near Natchez,

Fig. 63.

Engraved stone cylinder from Yucatan.

Fig. 64.

Hatchet of green stone from Costa Rica.

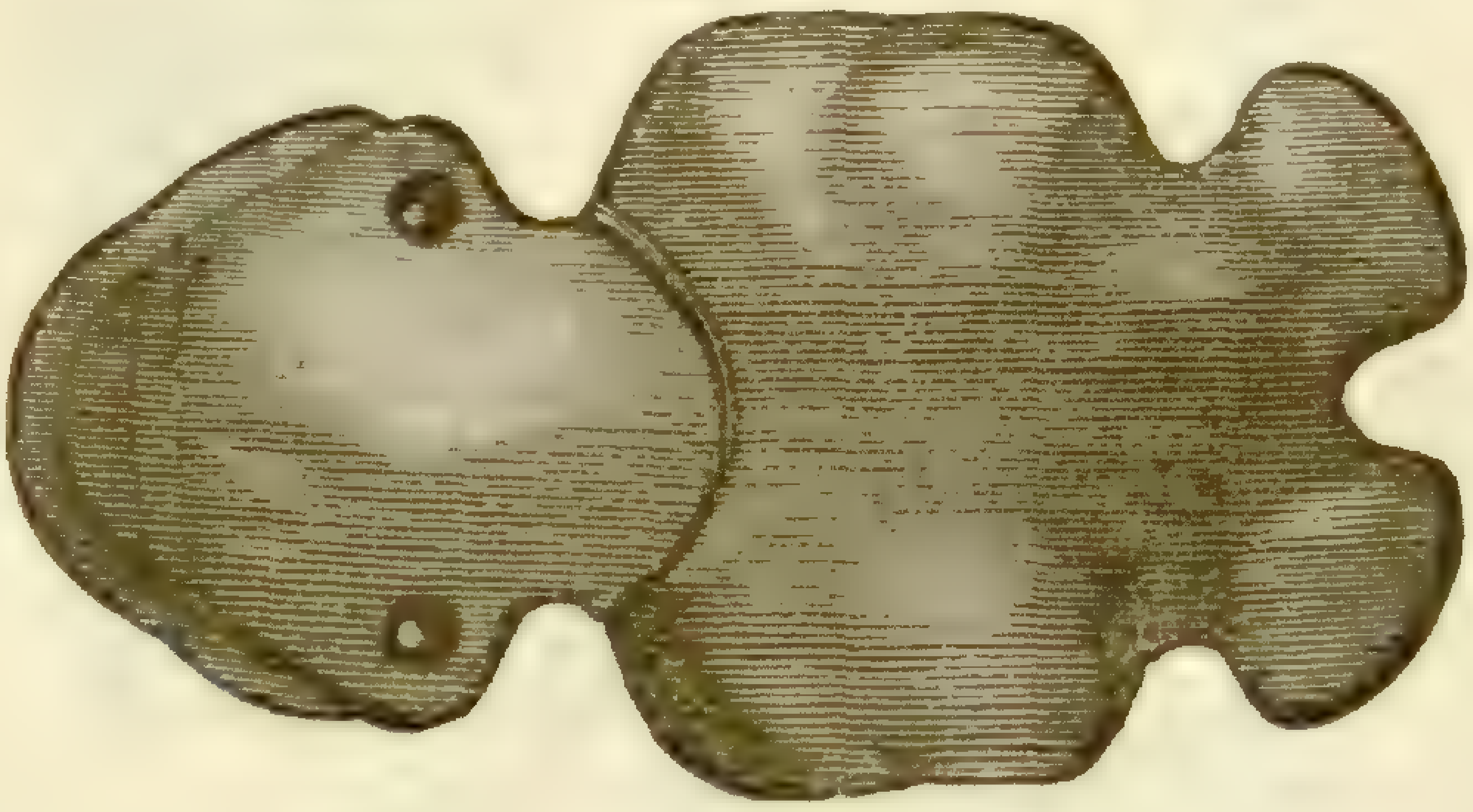
and appears to be a strange combination of the head of a siren of our western waters, or of the frog, with the human body. It is also pierced laterally, like those already described, doubtless for suspension.

I do not present FIGS. 63, 64, 65, and 66 as specimens of the *chalchihuitl*, but as showing the regard paid to green stones generally. It is one that pervades both continents and many nations, from the advanced Chinese,

Fig. 65.

Sculptured frog, Nicaragua.

Fig. 66.



Carved green stone found near Natchez.

to whom the green jade is sacred, to the savage dwellers on the banks of the Orinoco, among whom Humboldt found cylinders of hard green stones, the most highly prized objects of the several tribes, and some of which it must have required a lifetime to work into shape.

Of the carved chalchihuitls, like those described from FIG. 48 to FIG. 62, I have seen but three specimens outside of my own collection: one already alluded to in the Christy Museum of London, another in the late Uhde Museum near Heidelberg, and a third in the Waldeck collection in Paris.

The question how these obdurate stones were engraved, drilled, and sawn apart, or from the blocks of which they once formed a portion, is one likely to arise in most minds. It is one that has puzzled many inquirers; nor do I pretend to give an answer, except that the drilling was probably performed by a vibratory drill, composed of a thin shaft of cane or bamboo, the silica of which was reënforced by very fine sand, or the dust of the very article under treatment. The *striæ* shown in the orifices are proof of something of the kind, and the esteem attached to these stones by the aborigines proves that their value, like that of the mainspring of a watch, was due mainly to the amount of labor expended in their production.

As regards the sawing, of which the backs of FIGS. 51, 52, and 64, afford striking examples, we may find a clue in the accounts of the early chroniclers, who relate that they saw, in Santo Domingo and elsewhere, the natives use a thread of the *cabuya* (or agave), with a little sand, not only in cutting stone, but iron itself. The thread was held in both hands, and drawn right and left until worn out by attrition, and then changed for a new one, fine sand and water being constantly supplied.

Not a few inquirers entertain the hypothesis that most of the raised and sunken figures on various stones in Mexico, Central America, and the mounds of the United States, were produced by persistent rubbing or abrasion — a general hypothesis which I shall not dispute. But in objects from the mounds, as well as from other points on the continent, we have distinct evidence of the use of graving or incisive tools of some kind — as for instance in the hieroglyphics in FIG. 54, which are cut in a stone so hard that the blade of a knife produces scarcely any impression on its polished surface.

THE RECORD OF ZOOLOGICAL LITERATURE FOR 1868.* — We have before alluded to the great and increasing value of this work, and again urge its importance to American naturalists situated as many of them are away from libraries. We cannot understand how any entomologist can do without the part on insects; or the conchologist without that on shells; or the ornithologist be at all informed on the progress of his speciality unless he has this work to refer to. Its preparation is a labor of love by the editors and its liberal minded publisher, Mr. Van Voorst; and the work is a credit to their heads and hearts.

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*Vol. V. Edited by Dr. A. Gunther. London. Van Voorst, 1869. 8vo, pp. 592. Price reduced to $10 a vol. The Record for 1867 and 1868, also in parts: Part 1, *Vertebrates*, $3.50; Part 2, *Entomology*, $4.00; Part 3, *Mollusks*, *Crustacea* and the *Lower Animals*, $3.50. For sale at the Naturalist's Book Agency.

THE RECORD OF AMERICAN ENTOMOLOGY FOR 1869 will be published late in May. It will contain chapters by Messrs. Scudder and Uhler, Drs. Horn and Packard, and Baron Osten Sacken. Price, $1.00, which does not cover the cost of printing. We trust lovers of entomology will evince their zeal for the science by promptly subscribing to this useful publication. We hope that it will meet with better support than last year, as the publishers are sadly out of pocket in consequence of the small sale of the work for 1868.

THE WEEDS OF MAINE.* — This pamphlet, issued from the State Printing Office, consists of a few forms taken from the recent report of the Secretary of the Maine Board of Agriculture. The young man whose name appears as the author, has certainly shown a remarkable taste for botanical study. Wholly unassisted, even by friendly advice, he commenced the study of botany under great disadvantages and he has zealously prosecuted his herborizing during the too scanty leisure afforded by a Maine farm. The extraordinary power of diagnosis, which the author possesses, leads us to hope that he will devote the next few years to rigid disciplinary study, and then resume botanical work for which he seems to be so well fitted. The pamphlet itself is not to be criticised as a botanical work, and therefore we shall take the present opportunity to make it the text for a few very brief remarks. It is so easy to learn the names of plants and associate the two together, and so very difficult to learn *the plant itself*, that too many of our young botanical students are devoting their time simply to collecting, preserving, and naming specimens. In view of the many great questions in plant-physiology which are now being asked, it seems to be a sort of botanical dissipation to give up to the name what is due to the plant. These questions arise every week. The January 3d number of "Comptes rendus," contains a very interesting note by M. Prillieux upon the movements of chlorophyl grains under the influence of light. It is obvious that such a subject of study as this, one dealing with forces and with life itself, is more difficult than that of guessing at the names of all the Solidagos and half the Carices, but it is plain, too, that the thinkers of our time are asking that the former kind of work shall be done and faithfully done. Our plants are well named, and therefore we are justified in suggesting that our young botanical friends devote less time to mere "botanizing," as it is absurdly called, and give more time and better work to the study of *the plant*.

THE GEOLOGY OF THE NEW HAVEN REGION.† — Professor Dana describes the geology of New Haven and vicinity, with especial reference to the origin of its topographical features; showing by special facts, that the region, in the glacial era, like that of New England to the North, was moulded by ice, and that icebergs had no part in the matter, and the supposed iceberg sea over New England no existence.

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* By F. L. Scribner.

† From the Transactions of the Connecticut Academy. 1870. 8vo, pp. 112.

NATURAL HISTORY MISCELLANY.

BOTANY.

Collected Notes on the History of the American Oaks. — The first American oak noticed in botanical works is the white oak, mentioned by Parkinson in "Theatrum Botanicum," 1640, as *Quercus alba Virginiana*. Banister, 1686, in "Catalogus Plantarum in Virginiâ Observatarum" (in Rayi Historia) mentions *Quercus alba virens* (as *Virginiana sempervirens*), *Phellos* (as *Ilex Marilandica*) with a drawing by Ray, and *ilicifolia* Wg. (as *Q. pumila*).

Pluckenet in "Amagestum Botanicum," 1696, enumerates *Quercus esculi divisura*, which is *Q. rubra* L., *Q. Americana rubris venis* (*Q. coccinea* Wg.), var. γ (DC.), *Q. Virginiana salicis longiore folio* (*Q. Phellos* L.), *Q. Virginiana sempervirens* (*Q. virens* Ait.), *Q. castaneæ folio* (*Q. prinus palustris* Michx.), *Q. pumila castaneæ folio Virginiensis* (*Q. prinus pumila* Michx.), *Q. rubra*, *Phellos* and *Prinus palustris*, are illustrated.

Catesby in his "Natural History of Carolina," 1731, names *Q. alba*, *Prinus palustris* and *virens*. *Q. nigra* L., he calls *Q. Marilandica*; *Q. aquatica* Walt., he knows under the name *Quercus folio non serrato*; his *Q. esculi divisura* is *Q. Catesbæi* Michx., and his *Q. humilis salicis folio breviore* is *Q. cinerea* Michx.; all except the latter are illustrated.

Charlevoix in "Histoire et description générale de la Nouvelle France," Paris, 1744, knows *Q. prinus palustris* Michx., *Q. alba* L., *Q. virens* Ait., and *Q. nigra* L.; he gives drawings of the three latter.

In Gronovius' "Flora Virginica," 1743, containing the plants which John Clayton observed in Virginia, we find *Q. Phellos*, *nigra*, *aquatica*, *Prinus palustris*, *ilicifolia*, which he calls *Q. pumila bipedalis*, *Q. stellata* Wg. (to him *Q. alba*) and *falcata* Michx., which he calls *rubra seu hispanica*.

Kalm in his travels, or rather in his "Preliminary Report on his Botanical Collections," 1751, mentions only four oaks. *Q. rubra* and *alba*, the Spanish oak (*Q. falcata* Michx.) and another one with three lobes at the apex of the leaves, which is perhaps the var. *triloba* of the latter (*Q. triloba* Michx.). These are the American oaks known at the time when Linnæus' "Species Plantarum," 1753, was published. Linné established five species, *Q. Phellos*, comprising *Q. virens* and *cinerea* as varieties β and γ, *Q. nigra* α and β (α being *aquatica* Walt.), *Q. rubra*, comprising *rubra*, *coccinea* and *Catesbæi*, *Q. prinus* (*Q. prinus palustris* Michx.) and *Q. alba*.

Du Roi published (in "Harbke'she wilde Baumzucht," Braunschweig, 1771) a new species, *Q. palustris*.

Marshall published his "Arbustum Americanum," in 1785, in which he described the following oaks: *Q. alba*, *Q. alba minor*=*stellata* Wg., *Q. alba palustris*, which is apparently *Q. Prinus tomentosa* Michx., not *Q.*

alba. as Michaux says; *Q. nigra*=*coccinea* (*Q. tinctoria* Bartr.), *Q. nigra digitata*, *Q. nigra trifida*, *Q. nigra integrifolia*, the two latter certainly falling under *Q. nigra* L. var. β, *Q. nigra pumila*=*Q. ilicifolia* Wg., *Q. rubra*; *Q. rubra ramosissima*=*Q. palustris* Du Roi; *Q. rubra montana*=*Q. falcata* Michx.; *Q. rubra nana*=*Q. Catesbæi* Michx.; *Q. Phellos angustifolia* and *latifolia*=*Q. Phellos* L. (*silvatica* Michx.); *Q. Phellos sempervirens*=*Q. virens* Ait.; *Q. Prinus*=*Q. Prinus monticola* Michx.; *Q. Prinus humilis*=*Q Prinus pumila* Michx.

Wangenheim in his work on the "Americanische Holzarten," 1787, proposed some new species, of which three are acknowledged to-day: *Q. stellata* (the *Q. alba minor* of Marshall), *Q. ilicifolia* (the *Q. pumila* of Banister), and *Q. coccinea* (*Q. rubra* L., var. α). His *Q. cuneata* is *Q. falcata* Michx., var. γ *triloba*, and his *Q. uliginosa* is the *Q. aquatica* Catesby.

Walter in "Flora Caroliniana," published in the year 1788, enumerated thirteen oaks: 1, *Q. sempervirens* (*virens* Ait.); 2, *Q. Phellos*; 3, *Q. humilis* (*cinerea* Michx., var. γ. *humilis*); 4, *Q. pumila* (*cinerea* Michx., var. *pumila*); 5, *Q. Prinus*; 6, *Q. nigra*; 7, *Q. aquatica* (*nigra* L., α); 8, *Q. rubra* (*glandibus parvis globosis*, perhaps *Q. ilicifolia* Wang.?); 9, *Q. læris* (Catesbæi, Michx.?); 10, *Q. alba*; 11, *Q. lyrata*, which he first describes; 12, *Q. sinuata*, from the description of which it is not plain what it means; 13, *Q. villosa* already described by Wangenheim as *Q. stellata*. Michaux gives Catesby, who indeed described, but did not name it, the authorship of *Quercus aquatica*. De Candolle makes Walter the author of it; the latter published his Flora one year after the publication of Wangenheim's work, in which the species is described and called *uliginosa*. The descriptions of both the authors are as poor as possible; both the names derived from the hygrophile nature of the tree are good enough. only that the right of priority, acknowledged as a general rule by the international Botanical Congress at Paris, is in favor of Wangenheim's name. But the name *aquatica* is indeed older, and was first used by Clayton in *Gronovius*, so his name should be added. By the way, Walter is noteworthy for his modesty, which should be imitated by many an eager species-maker. His work is full of "Anonymos," and in the preface he says: "*Libertatem appellative assignandi paucis tantum concedendam sentit, quamobrem iis, qui in hac scientia merito duces sunt, jus reliquit dicendi quænam sint nomina plantis nunc primum descriptis.*" If so many botanists, who. overrating the doubtful merit of having created a new species, fill our botanical books with names. would follow modest old Walter, a good deal of wasted paper could be saved, and a good deal of unnecessary work. Indeed, it is much easier to make new species, than to clean those Augean stables of synonyms.

Aiton in "Kew Garden," 1789, calls the long-known *Q. sempervirens* of Catesby *Q. virens*; the latter name is adopted.

William Bartram, in his "Travels through North and South Carolina," Phil. 1791, proposes the new species *Q. tinctoria*, which De Candolle in

his Prodromus reunites with *Q. coccinea* Wg., as var. γ *tinctoria*. Bartram's *Q. hemispherica* and *dentata* are both varieties of *Q. aquatica*.

Luis Née joined the expedition of Malaspina from 1789 to 1794; he visited South America, Mexico and the Pacific Islands, and brought in his rich botanical collections to Europe, the first specimens of oak from those countries, which have been published in "Annales de Ciencias Naturales" by Cavanilles, 1798. Amongst these oaks are two California species, *Q. lobata* and *agrifolia*; the latter was already known to Plucknet as *Ilex foliis agrifolii Americana* (in "Phytographia," London, 1691–93, with a drawing, but without flower or fruit); the others are Mexican, *Q. circinata, magnoliæfolia, salicifolia, microphylla, splendens, acutifolia, elliptica, castanea*, and *candicans*, all considered yet to be "good species." His *Q. lutea* and *macrophylla* come under *magnoliæfolia*; his *diversifolia* is a variety of *Q. pedunculuris* Née, changed by Willdenow into *Q. tomentosa*, because the character Née took the name from is variable, and Neè's specimen is defective; *Q. rugosa* Humboldt and Bonpland changed into *Q. crassifolia*, Née's unique specimen being very defective and doubtful.

André Michaux explored from 1785 to 1796 the forests of Eastern North America. He published in 1801 his "Histoire des Chênes l'Amérique Septentrionale," in which for the first time is pointed out a character, very important to the methodical arrangement of the oaks, the time of maturation. His arrangement is the following:

I. The leaves of the old tree not bristle-pointed: fruit peduncled, annual.
   1. Leaves lobed. *Q. obtusiloba* (*stellata* Wg.), *macrocarpa* (n. sp.) *lyrata* Walt., *alba* L.
   2. Leaves toothed. *Q. Prinus*, with 5 varieties: *palustris, monticola, acuminata, pumila* and *tomentosa*.
   3. Leaves entire. *Q. virens*, but the fruits are according to him biennial.

II. Leaves of the old tree bristle-pointed: fruit sessile, biennial.
   1. Leaves entire. *Q. Phellos*, with three varieties, *silvatica, maritima*, and *pumila*. *Q. cinerea*, *Q. imbricaria* (n. sp.), *Q. laurifolia*, with the variety *obtusifolia*.
   2. Leaves with short lobes. *Q. aquatica*, *Q. nigra*, *Q. tinctoria*, with two varieties (*angulosa* and *sinuosa*). *Q. triloba*.
   3. Leaves deeply lobed. *Q. Banisteri* (*ilicifolia* Wg.), *Q. falcata* (*hispanica* Clayton, *discolor* Ait., *elongata* Willd.), *Q. Catesbæi*, *Q. coccinea* Wg., *Q. palustris* Du Roi and *Q. rubra* L.

The same species are enumerated in his "Flora Americana," published by L. C. Richard, but without this arrangement. The ripening of fruit is not there mentioned at all.

Willdenow in "Species Plantarum," 1797–1810, enriched (?), the genus Quercus by new species, making out of the five varieties of Prinus, five species: *Prinus, montana, bicolor* (*tomentosa*), *castanea* (*acuminata*) and *Prinoides* (*pumila*); the varieties of *Phellos*, *maritima* and *pumila* he

changed into two species of the same name; *tinctoria* var., *sinuosa* into *discolor*, and his *Q. myrtifolia* is probably a variety of *Q. aquatica*.

Persoon in "Synopsis Plantarum," 1805 enumerates eighty-five oaks, of which forty-six are American; thirty from the eastern part of North America, two Californian and fourteen Mexican; all mentioned above.

F. A. Michaux, the son, published his "Arbres foréstières," 1810–13. He calls *Q. Prinus tomentosa* of his father *Q. Prinus discolor*, and proposed five new species: *Q. heterophylla*, which proves to be an hybrid; *ambigua* and *borealis*, which fall under *Q. coccinea; ferruginea*, which is *Q. nigra* L. *β.*; and *olivæformis*, which is *macrocarpa*.

Humboldt and Bonpland collected (1799–1804) twenty-three new species, of which thirteen are now considered as good ones: *Q. confertifolia, crassifolia, crassipes, depressa, Humboldtii, lanceolata, laurina, obtusata, pulchella, repanda, reticulata, Tolimensis, Xalepensis;* four are dubious: *Q. Amalguerensis, chrysophylla, glaucescens* and *sideroxyla;* three had been described already by Née: *Q. stipularis = splendens* Née; *tridens = castanea* Née var. *γ*, and *Mexicana = Castanea* Née var. *E*; three are the same as other species of the same authors: *Q. spicata* is *reticulata* H. B.; *pandurata* and *ambigua* are *obtusata* H. B., var. *β* and *γ*. They are all Mexican, except three from New Granada: *Humboldtii, Tolimensis* and *Almaguerensis*. They are described in "Plantæ Æquinoctiales," 1805–1818.

In Pursh's "Flora," 1814, are mentioned thirty-four species; except *agrifolia*, all are eastern and comprising all the species of Michaux, with the additions of the younger Michaux and Willdenow. In his arrangement the ripening o the fruit takes the first place as a diagnostic character, the second the presence or absence o the bristles of the leaves; the third the form of the leaves.

Nuttall in "Genera of North American Plants," 1818, follows the same disposition, but the number of his species is thirty-two. He calls *Q. Prinus discolor* Mich. fil. *Q. Michauxii*, but at the same time he keeps *Q. bicolor* Willd. as a species with the variety *mollis* (probably *Q. velutina* Lam., which he believes is *Q. filiformis* Muhl.). Afterwards he proposes three more species: *Q. Gambelli, Leana* (a hybrid) and *dumosa* (in "Silva Americana,") a doubtful species. Of Mexican species he knew only fifteen.

Elliott in a "Sketch of the Flora of Georgia," 1824, enumerating twenty-six oaks, adds to those already known, a variety of *falcata* Michx. (var. *pagodæfolia*).

Chamisso and Schlechtendal, 1830, in "Linnæa," v., described some new Mexican oaks from specimens collected by Schiede and Deppe: *Q. calophylla, polymorpha, laurifolia, germana* and *oleoides*, the latter being *Q. virens* Ait. These make the western species amount to thirty-six.

Hooker and Arnott published in 1841, the "Botany of Capt. Beechey's Voyage," comprising the plants which Lay and Collie, 1825–28, collected. We find amongst them three oaks, two Californian: *Douglasii* and *densiflora*, and one Mexican: *aristata*. In "Hooker's Flora boreali Americana,"

1833–40, is described as new *Q. Garryana* by Menzies and Douglas, found in Oregon; and in "Icones," 1837–45; *Quercus corrugata* from Guatemala.

Bentham describes in the Botany of the voyage of the Sulphur, under command of Capt. Belcher, the collections of Barclay, Hinds and Sinclair. He proposes a new species of oak, *Quercus Hindsii*, from California which is nothing else than *Q. lobata* Née.

From the same author are the "Plantæ Hartwegianæ," 1839–42, containing the plants which Hartweg, 1836–40, collected in Mexico, etc. There we find a number of new species: *Q. barbinervis, glabrescens, Grahami, Skinneri, Sonomensis, dysophylla, undulata, salicifolia*, the two latter names, as already used, De Candolle changed into *Benthami* and *Tlapuxahuensis.* Others had already been described: *Q. Mexicana* is *crassipes* H. B., *Alamo* = *callophylla*, Cham. and Schl., *Hartwegi* = *obtusata* H. B., *petiolaris* = *polymorpha* Cham. and Schl., *callosa* = *tomentosa* Willd. Others are varieties; *tomentosa* = *tomentosa* Willd., var., *compressa* = *acutifolia* var., *laurifolia* = *densiflora* Hook, Arn. var. β. Hartwegi; *Douglasii* = *Douglasi.* Hook. Arn. var.; one proposed as a variety was afterwards taken as a species by Liebmann: *Q. obtusata* var. = *Q. laeta* Liebm. At the same time two Belgian botanists, Galeotti and Ghiesbreght, travelled in Mexico, and collected many oaks, which have been published, 1843, in "Bulletin of the Académie des Sciences of Bruxelles," by Galeotti and Martens: *Q. lanigera, lutescens, Ghiesbreghtii, nitens, insignis, rugulosa, glaucoides, callosa* (the latter described by Liebmann as *Q. laxa*); *Q. Galeottii. cordata, pubinervis* (not in Prodromus. perhaps *strompocarpa* Liebm.), *mollis* (perhaps *crassifolia*), are doubtful. Such as were already described are *Q. varians* = *polymorpha* Ch. and Schl., *nitida* = *acutifolia* Née, *acuminata* and *intermedia* = *calophylla* Ch. Schl., *spinulosa* = *crassifolia* H. B., *affinis* = *obtusata* H. B., *decipiens* = *reticulata* H, B., *laurina* = *depressa* Bth., *lanceolata* (not H. B.) = *Oaxacana* Liebm.

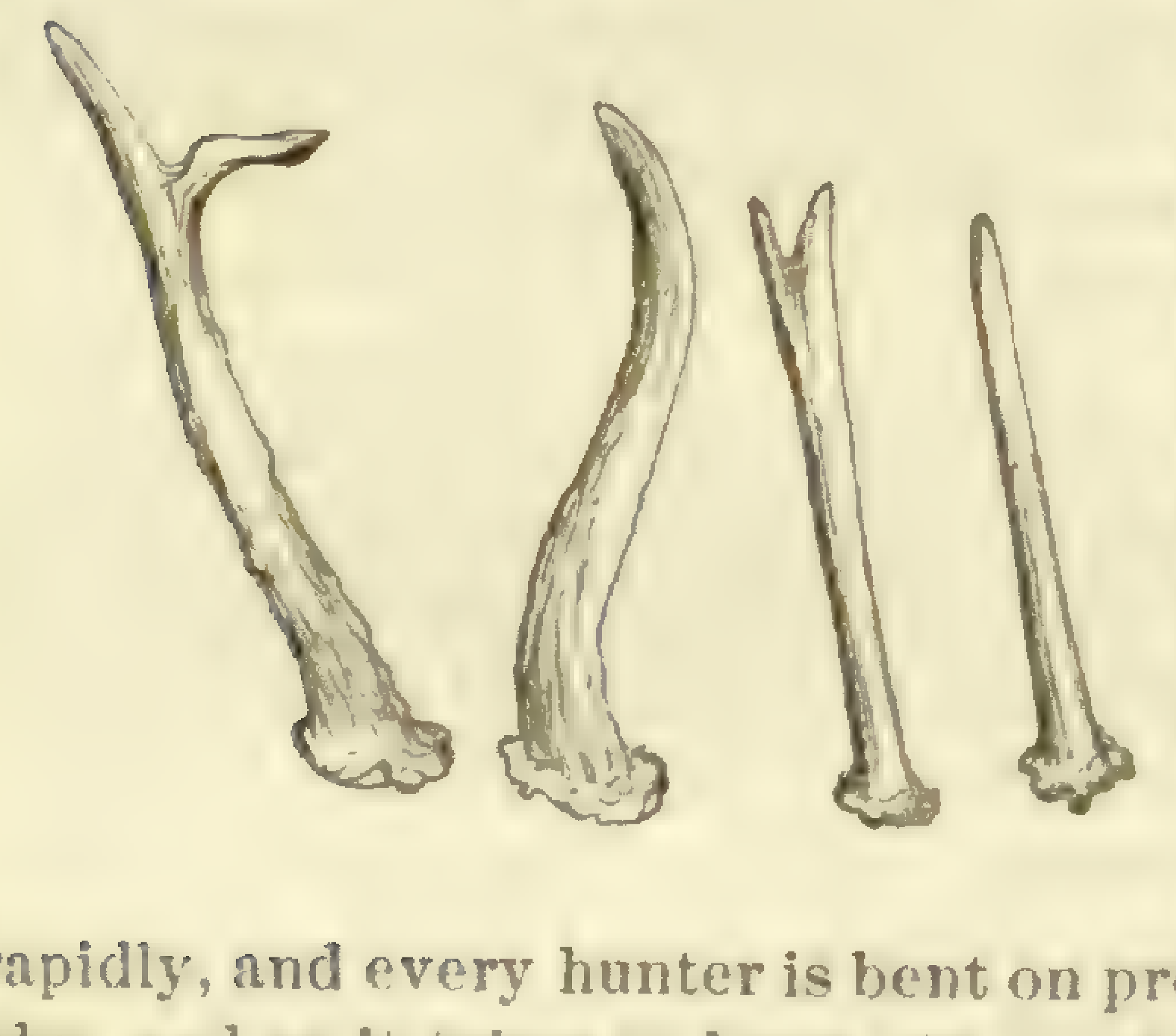
Liebmann travelled in Mexico in 1841–43. His own collection and those of Oerstedt and of Seemann furnished the material for his great work on "American Oaks." The new species are *Q. granulata, linguæfolia, nectandræfolia, berberidifolia, citrifolia. Costaricensis. Seemanni, Sartorii, Cortesii, lata, Drummondii, strompocarpa, grandis, Warscewiczii. chrysolepis.* Species already described are *Q. Fendleri*=*undulata* Torr. (in Annals Lyceum of New York, 1827), *furfurarea*=*acutifolia* H B., *commutata*=*nitens* M. G., *tristis*=*castanea* Née. *tuberculata*=*polymorpha* Cham. & Schl., *retusa* =*virens* Ait.; varieties of described species are *Q. resinosa*=*magnoliæfolia* Née, γ *rudinervis*=*obtusata* H. B. γ, *Neæi*=*Douglasii* var. γ, *longifolia*= *acutifolia* var. *ocotæfolia*=*nitens* var. γ, *perseæfolia* and *microcarpa*=*elliptica* Née var. His *Q. oocarpa* is the same as his *Warczewiczii*; what he took for *laurina* is *lanceolata* H. B., var. β.; *Q. Grahami* Bth., is *acutifolia* Née, his *lancifolia* is a new species by A. DeCandolle changed into *leiophylla; Q. bumelioides, cuneifolia* (*Chinantlensis*), *excelsa, eugeniaefolia, flavida, floccosa, fulva, jurgensenii, Oaxacana, Orizabae, sapotaefolia, Segoviensis, serra, sororia, scytophylla, turbinata* (by A. DC., changed into *Guatimalen-*

sis), are doubtful species. From Wright's collection he described Q. *pungens*, *hastata* and *grisea*, already published by Torrey, the two former as *Q. Emoryi* (in Emory's Report) the latter as *Q. oblongifolia* in Sitgreaves' Zuni Expedition. Other species of Torrey had been already named, when he published them: *Q. crassipocula* (in Williamson's Report) is *chrysolepis* Liebm., described in "Plantæ Hartwegianæ;" *Q. tinctoria* var. *Californica* (in Whipple's Report) is *Sonomensis* Bth.; *longiglanda* in "Frem. Geogr. Mem. of Cal.," is *lobata* Née; *echinacea* (in Whipple's Rep.) is *densiflora*, *oxyadenia* (in Sitgreaves' Report) is *agrifolia* Née. In "Mexican Boundary Survey" (1858), is a new species described as *Q. acutidens* from California, omitted by De Candolle; another, *obtusifolia*, falls under *undulata* Torr., as a variety; another variety is there mentioned, *Q. coccinea* var. *microcarpa*. Kellogg published in the "Proceedings of the California Academy of Sciences," vol. i, some new species, which are not new: *Q. fulvescens* is *chrysolepis* Lbm.; *acutiglandis* is *agrifolia* Née; *Ransomi* is *lobata* Née. His *Q. Morehus* (Proc. Cal. Acad. Sci. ii) is doubtful. Newberry proposed what Torrey took for a variety of *tinctoria* (*i.e. coccinea*), as a new species, *Q. Kelloggii*, which falls under *Sonomensis* Benth. Curtis, 1849, proposed a new eastern species, *Q. Georgiana*. Shuttleworth's *Q. Floridana* is the var. β. *Floridana* of *Q. stellata* according to De Candolle, perhaps Chapman's var. *parvifolia?* Endlicher in "Genera Plantarum," Suppl. iv, 2, 1847, enumerates one hundred and ninety-seven described oaks, of which one hundred and one are American. — FRED. BRENDEL, *Peoria, Ill.* (*To be concluded.*)

ZOOLOGY.

SPIKE HORNS. — The article in the December number of the NATURALIST seems to me to be the result of careless observation. The 'Common Deer," *Cervus Virginianus*, 'begins growing his first pair of horns when about one year old; these horns are from four to nine inches long and sometimes one of them will have a single branch of an inch or two long; these horns are shed when the animal is about two years old (Fig. 67). At this age I have seen deer that had attained their full growth in height, and to an ordinary observer would be thought old animals.

Fig. 67.



The number of persons hunting in the Adirondacks increases very rapidly, and every hunter is bent on procuring a fine pair of horns as a trophy, and as it takes at least six or eight years for a buck to grow a fine

pair of antlers, you can see that the chances for a deer to attain a full development is growing more unfavorable every year. The reason why *spike horns seem to be* more numerous than formerly, is that there are more hunters and fewer old deer. If any one can show me a spike horn of a deer that is three or more years old, that is not the result of accident, I would like to get it.

The same difficulty exists with the moose and carraboo. It is now almost impossible to procure a large and well developed pair of moose or carraboo horns, while some years ago they were plenty. — W. J. Hays.

Adirondack's Reply. — In replying to the criticism of Mr. Hays, I can, unless I can take time to collect testimony, only reiterate my former statements, that I shot on Louis Lake a buck with spike-horns, which was not a yearling, nor a two years old, nor a three years old even, but a *large* buck, of full age and size; and that I afterwards shot on Cedar Lakes a buck with spike-horns, which was pronounced to be a "three year old." I will add that I have conversed on the subject of "spike-horn bucks" with a number of hunters and guides, some born in the Adirondacks, others who have lived there many years, and that the testimony of all agreed that spike-horn bucks are of all ages and sizes, and that they are slowly increasing in the southern part of the Adirondack region.

When I shot the large buck on Louis Lake, Silas Call, then a noted and most intelligent guide, now keeper of the inn at Northville, was with me. He will undoubtedly remember the facts and testify to them if called upon. When I shot the smaller spike-horn, William S. Robinson, Esq., of Malden, Mass., stood by my side. Hon. F. W. Bird, of Walpole, was of the party, and saw the deer at the shanty. I do not know that either of these gentlemen has ever given attention to the subject of spike-horn bucks; but Mr. Bird has hunted a good many years in the southern Adirondacks, and I think must know something about them. [I beg pardon of these gentlemen for using their names without their consent, but, living at a place reached only by infrequent mails, I have no time to procure it.] David Sturges, the keeper of the inn at Lake Pleasant, born there, and one of the best and most successful guides and hunters of the Adirondacks, could give valuable testimony on the question. He has been upon the lookout all through the past autumn and early winter, for the head of a large spike-horn buck for you, but has not succeeded in procuring one. Bucks have now lost their horns, and a head cannot be procured unless with horns "in the velvet," before next September. I hope then Mr. Sturgis will be more successful. But spike-horn bucks, of full age and size, are not yet common, and a young one will not answer your purpose.

Of the figures of "spike-horns" (Fig. 67) by Mr. Hays, neither resembles very closely the true spike-horn. I have the pair from the young spike-horn buck shot by me, and will send them to you whenever I go to a place reached by the express. I will send with them the antlers of a common "two year old" buck. You will at once see the difference. You will see too, what was the fact, that the spike-horns came from the larger deer.

The distance between the horns shows this. The spike-horns are about half an inch farther apart than the others, showing the spike-horn buck to have been probably a year older than the other. The hair on the skull of the spike-horn buck is shorter than that on the other; the spike-horn was shot just as deer were attaining the "blue coat;" the other was shot a month or six weeks later. This is the reason of the difference.

Notwithstanding what Mr. Hays says, I never saw a yearling buck (that is a buck in his second year, wearing his first pair of horns) that could be said to have "attained full growth," in "height," or anything else. I never saw a "two years old" (in his third year) that had attained full growth in all respects — nor yet "a three years old." The saddle of a two years old will never exceed forty or fifty pounds in weight. I doubt whether the saddle of a yearling ever reaches the smaller weight, while I have seen full grown antlered bucks, whose saddles weighed over seventy pounds; and I have the head of one whose saddle weighed a little over eighty pounds. I have heard of bucks still heavier. Without the antlers, there may in some cases be difficulty in distinguishing between a two years old and a three years old; but there is *never* any difficulty in distinguishing between either of these and a buck of six or seven years. A yearling (in his second year) can always be known by his size. A buck in the spring, when he attains the full age of two years, never has horns, and has had none for some time. *While his first pair of horns lasts* surely he can never be said to have "attained full growth" in any respect. Shot in the fall previous, his youth is very manifest. Yet it is the first pair of horns only that are ever "spikes" in a common *C. Virginianus.*

Did Mr. Hayes ever hunt south of Raquette Lake, or ever south of Long Lake? I think it probable that he enters the Adirondacks over the more common route by way of Keesville and the Saranac Lakes, and hunts in the Raquette River country, north of Long Lake. I have hunted through the whole region from the Saranac Lakes south to Saratoga and Fulton counties, and west into Herkimer county and the "Brown tract." But I have visited the country north of Long Lake only once.

The writer in the "Saginaw Republican" apparently knows little of deer. A yearling buck (in his second year, with his first pair of horns) has spike-shaped horns; but at the rutting season he is scarcely eighteen months old, and is quite too young and small to be a rival of a full-grown buck, while a two years old buck (in his third year with his second pair of horns) has antlers which are scarcely more formidable weapons than the antlers of a full-grown buck. In point of fact I believe the full-grown bucks have altogether the advantage with the does.—ADIRONDACK.

GEOLOGY.

NEW ANIMAL REMAINS FROM THE CARBONIFEROUS AND DEVONIAN ROCKS OF CANADA. — Principal Dawson has discovered another species of amphibian from the Joggins Coal Mine, the *Baphetes minor*; the remains consisting of a lower jaw six inches long. The author also noticed some

insect remains found by him in slabs containing Sphenophyllum. They were referred by Mr. Scudder to the Blattariæ. From the Devonian beds of Gaspè the author stated that he had obtained a small species of Cephalaspis, the first yet detected in America. Mr. Etheridge remarked that the Cephalaspis differed materially in its proportions from any in either the Russian or British rocks. — *Nature.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Maryland Academy of Sciences. — By this title we announce the organization of a Natural History Society in the city of Baltimore. We are glad that the long continued efforts of the gentlemen who are its present officers have at length resulted in the establishment of a society regularly chartered, and with some fifty members. They have, as it appears from an official communication to the Director of the Peabody Academy, already secured proper apartments, centrally located, and received donations of collections of books and specimens, and begun the regular scientific work of the society. The circular which the academy has published certainly states their case very fairly and modestly to the citizens of Baltimore, and we do not see how they can do otherwise than sustain the new society if they care at all for the completion of their system of public instruction.

Such societies devoted to the exposition of the natural resources of the country have a recognized value in Europe and in some of the cities of this country. But their refining influence upon society, the cultivation which results from their publications and teachings, especially if they become sufficiently well endowed to institute lectures to teachers and advanced students of the public schools, as the Boston Society has done, is not at all appreciated or even understood.

The basis of the new academy, as announced in article two, is broad and effective, and ought to insure its members the moral and material support of the community which is to be benefited by the labor of its members. As stated in this article "its object shall be to promote scientific research, and to collect, preserve and diffuse information relating to the sciences, *especially those connected with the natural history of Maryland.*"

The officers of the academy are Philip T. Tyson, president; John G. Morris, D.D., vice-president; Edwin A. Dalrymple, D.D., corresponding secretary; Charles C. Bombaugh, M.D., recording secretary; John W. Lee, treasurer; P. R. Uhler, curator; A. Snowden Piggott, M.D., Librarian; J. B. Uhler, J. DeRosset, M.D., and F. E. Chatard, jr., M.D., assistant curators.

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THE

AMERICAN NATURALIST.

Vol. IV.—JUNE, 1870.—No. 4.

THE SURFACE GEOLOGY OF THE BASIN OF THE GREAT LAKES AND THE VALLEY OF THE MISSISSIPPI.

BY PROFESSOR J. S. NEWBERRY.

THE area bounded on the north by the Eozoic highlands of Canada, on the east by the Adirondacks and the Alleghanies, and on the west by the Rocky Mountains, though now, and apparently always, drained by two systems of water-courses, may be properly considered as one topographical district; since much of the water-shed which separates its two river systems is of insignificant height, is composed of unconsolidated "Drift" materials, has shifted its position hundreds of miles, as the water level in the great lakes has varied, and was for a long interval submerged beneath a water connection uniting both drainage systems in one.

In this great hydrographic basin the surface geology presents a series of phenomena of which the details, carefully studied in but few localities, still offer an interesting and almost inexhaustible subject of investigation, but which, as it seems to me, are already sufficiently well known to enable us to write at least the generalities of the history which they record.

The most important facts which the study of the "Drift

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phenomena" of this region have brought to light are briefly as follows:

1st. In the northern half of this area down to the parallels of 38°–40°, we find, not everywhere, but in most localities where the nature of the underlying rocks is such as to retain inscriptions made upon them, the upper surface of these rocks planed, furrowed or excavated in a peculiar and striking manner, evidently by the action of one great denuding agent. No one who has seen glaciers and noticed the effect they produce on the rocks over which they move, upon examining good exposures of the markings to which I have referred, will fail to pronounce them the tracks of glaciers.*

Though having a general north-south direction, locally the glacial furrows have very different bearings, conforming in a rude way to the present topography, and following the directions of the great lines of drainage.

On certain uplands, like those of the Wisconsin lead region, no glacial furrows have been observed (Whitney), but on most of the highlands, and in all the lowlands and great valleys, they are distinctly discernible if the underlying rock has retained them.

2d. Some of the valleys and channels which bear the marks of glacial action—evidently formed or modified by ice, and dating from the ice period or an earlier epoch—are excavated far below the present lakes and water-courses which occupy them.

These valleys form a connected system of drainage, at a lower level than the present river system, and lower than could be produced without a continental elevation of several hundred feet. A few examples will suffice to show on what evidence this assertion is based.

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*From my own observations on the action of glaciers on rock surfaces in the Alps and in Oregon and Washington Territory, I do not hesitate to assert that no other agent *could* have produced such effects. A different view is taken of this subject, it is true, but only by those who either have never seen a glacier or have never seen the markings in question. The track of a glacier is as unmistakable as that of a man or a bear.

Lake Michigan, Lake Huron, Lake Erie, and Lake Ontario are basins excavated in undisturbed sedimentary rocks. Of these Lake Michigan is six hundred feet deep, with a surface level of five hundred and seventy-eight feet above tides; Lake Huron is five hundred feet deep, with a surface level of five hundred and seventy-four feet; Lake Erie is two hundred and four feet deep, with a surface level of five hundred and sixty-five feet; Lake Ontario is four hundred and fifty feet deep, with a surface level of two hundred and thirty-four feet above the sea.

An old, excavated, now-filled channel connects Lake Erie and Lake Huron. At Detroit the rock surface is one hundred and thirty feet below the city. In the oil region of Bothwell, etc., from fifty to two hundred feet of clay overlie the rock. What the greatest depth of this channel is, is not known.

An excavated trough runs south from Lake Michigan—filled with clay, sand, tree trunks, etc.—penetrated at Bloomington, Illinois, to the depth of two hundred and thirty feet.

The rock bottoms of the troughs of the Mississippi and Missouri, near their junction or below, have never been reached, but they are many feet, perhaps some hundreds, beneath the present stream-beds.

The borings for oil in the valleys of the Western rivers have enabled me not only to demonstrate the existence of deeply buried channels of excavation, but in many cases to map them out. Oil Creek flows from seventy-five to one hundred feet above its old channel, and that channel had sometimes vertical and even overhanging cliffs. The Beaver, at the junction of the Mahoning and Shenango, runs one hundred and fifty feet above the bottom of its old trough.

The Ohio throughout its entire course runs in a valley which has been cut nowhere less than one hundred and fifty feet below the present river.

The Cuyahoga enters Lake Erie at Cleveland, more than

one hundred feet above the rock bottom of its excavated trough. The Chagrin, Vermilion, and other streams running into Lake Erie exhibit the same phenomena, and prove that the surface level of the lake must have once been at least one hundred feet lower than now.

The bottom of the excavated channel in which Onondaga Lake is situated, and the Salina salt-wells bored, is at least four hundred and fourteen feet below the surface level of the lake and fifty feet below the sea level. (Geddes, Trans. New York State Agricultural Society, 1859.)

The old channel of the Genesee River at Portage, described by Professor Hall in the Geology of the Fourth District of New York; the trough of the Hudson, traceable on the sea bottom nearly one hundred miles from the present river mouth; the deeply buried bed of the Lower Mississippi, are additional examples of the same kind; while the depth to which the Golden Gate, the Straits of Carquinez, the channel of the lower Columbia, the Canal de Haro, Hood's Canal, Puget Sound, etc., have been excavated, indicates a similar (perhaps simultaneous) elevation and erosion of the Western coast of America.

The falls of the Ohio—formed by a rocky barrier across the stream—though at first sight seeming to disprove the theory of a deep continuous channel in our Western rivers, really afford no argument against it, for here, as in many other instances, the present river does not follow accurately the line of the old channel below, but runs along one or the other side of it. In the case of the Louisville falls the Ohio runs across a rocky point which projects into the old valley from the north side, while the deep channel passes under the lowland on the south side, on part of which the city of Louisville is built.

The importance of a knowledge of these old channels in the improvement of the navigation of our larger rivers is obvious, and it is possible it would have led to the adoption of other means than a rock canal for passing the Louisville

falls, had it been possessed by those concerned in this enterprise.

I ventured to predict to General Warren that an old filled-up channel would be found passing around the Mississippi rapids, and his examinations have confirmed the prophecy. I will venture still farther, and predict the discovery of buried channels of communication between Lake Superior and Lake Michigan—probably somewhere near and east of the Grand Sable—at least, between the Pictured Rocks and the St. Mary's River—between Lake Erie and Lake Ontario through Canada,—between Lake Ontario* and the Hudson by the valley of the Mohawk,—between Lake Michigan and the Mississippi, somewhere along the line I have before indicated. I also regard it probable that a channel may be found connecting the upper and lower portions of the Tennessee River, passing around the Mussel Shoals. This locality lies outside of the area where the Northern Drift deposits were laid down to fill and conceal ancient channels, but the excavation and the filling up of the channel of the Tennessee—like that of the Ohio—were determined by the relative altitude of the waters of the Gulf. The channel of the Lower Tennessee must have been excavated when the southern portion of the Mississippi valley was higher above the Gulf level than now, and Professor Hilgard has shown that at a subsequent period, probably during the Champlain epoch, the Gulf coast was depressed five hundred feet below its present relative level. This depression must have made the Lower Mississippi an arm of the sea, by which the flow of the Ohio

* When the water in the lake basin had subsided to near its present level, its old avenues of escape being all silted up by the Drift clays and sands, the surplus made its exit by the line of lowest levels wherever that chanced to run. As that happened to lie over the rocky point that projected from the northern extremity of the Alleghanies into the lake basin, there the line of drainage was established in what is now known as Niagara River.

Though among the most recent of the events recorded in our surface geology, this choice of the Niagara outlet by the lake waters was made so long ago that all the erosion of the gorge below the falls has been accomplished since. The excavation of the basin into which the Niagara flows — the basin of Lake Ontario, of which Queenstown Heights form part of the margin — belongs to an epoch long anterior.

and Tennessee was arrested, their channels filled, terraces formed, etc. If the Upper Tennessee has, as appears, a channel lower than the Mussel Shoals, it must be somewhere connected with the deep channel of the lower river.

It should be said, however, that it by no means follows that where an old earth-filled channel passes around the rocky barrier by which the navigation of our rivers is impeded, it will be most convenient and economical to follow it in making a canal to pass the obstacle, as the course of the old channel may be so long and circuitous that a short rock cutting is cheaper and better. The question is, however, of sufficient importance to deserve investigation, before millions of dollars are expended in rock excavation.

If it is true that our great lakes can be connected with each other and with the ocean, both by the Hudson and Mississippi, by ship canals,—in making which no elevated summits nor rock barriers need be cut through,—the future commerce created by the great population and immense resources of the basin of the great lakes may require their construction.

3d. Upon the glacial surface we find a series of unconsolidated materials generally stratified, called the "Drift deposits."

Of these the first and lowest are blue and red clays (the Erie clays of Sir William Logan), generally regularly stratified in thin layers, and containing no fossils, but drifted coniferous wood and leaves. Over the southern and eastern part of the lake basin, these clays contain no boulders, but towards the North and West they include scattered stones, often of a large size; while in places beds of boulders and gravel are found resting directly on the glacial surface.

In Ohio the Erie clays are blue, nearly two hundred feet in thickness, and reach up the hill-sides more than two hundred feet above the present surface of Lake Erie. On the shores of Lake Michigan these clays are in part of a red color, showing that they have been derived from different rocks, and they there include great numbers of stones.

On the peninsula between Lake Erie and Lake Huron the Erie clays fill the old channel which formerly connected these lakes, having a thickness of over two hundred feet, and containing a few scattered stones.

4th. Above the Erie clays are sands of variable thickness and less widely spread than the underlying clays. These sands contain beds of gravel, and, near the surface, teeth of elephant have been found, water-worn and rounded.

5th. Upon the stratified clays, sands, and gravel of the Drift deposits are scattered boulders and blocks of all sizes, of granite, greenstone (diorite and dolerite), silicious and mica slates, and various other metamorphic and eruptive rocks, generally traceable to some locality in the Eozoic area north of the lakes. Among these boulders many balls of native copper have been found, which could have come from nowhere else than the copper district of Lake Superior.

Most of these masses are rounded by attrition, but the large blocks of Corniferous limestone which are scattered over the southern margin of the lake basin in Ohio show little marks of wear. These masses, which are often ten to twenty feet in diameter, have been transported from one hundred to two hundred miles south-eastward from their places of origin, and deposited sometimes three hundred feet above the position they once occupied.

6th. Above all these Drift deposits, and more recent than any of them, are the "lake ridges,"—embankments of sand, gravel, sticks, leaves, etc., which run imperfectly parallel with the present outlines of the lake margins, where highlands lie in the rear of such margins. Of these, the lowest on the South shore of Lake Erie is a little less than one hundred feet above the present lake level; the highest, some two hundred and fifty feet. In New York, Canada, Michigan, and on Lake Superior, a similar series of ridges has been discovered, and they have everywhere been accepted as evidence that the waters of the lakes once reached the points

which they mark. That they are nothing else than ancient lake beaches we shall hope to prove farther on.

In the southern half of the Mississippi valley the evidences of glacial action are entirely wanting, and there is nothing corresponding to the wide-spread Drift deposits of the north. We there find, however, proofs of erosion on a stupendous scale, such as the valley of East Tennessee, which has been formed by the washing out of all the broken strata between the ridges of the Alleghanies and the massive tables of the Cumberland Mountains,—the cañons of the Tennessee, one thousand six hundred feet deep, etc. Here also, as in the lake basin, the channels of excavation pass far below the deep and quiet waters of the lower rivers; proving by their depth that they must have been cut when the fall of these rivers was much greater than now.

The history which I derive from the facts cited above is briefly this:

1st.—That in a period probably synchronous with the glacial epoch of Europe,—at least corresponding to it in the sequence of events,—the northern half of the continent of North America had a climate comparable with that of Greenland; so cold, that wherever there was a copious precipitation of moisture from oceanic evaporation, that moisture was congealed and formed glaciers which flowed by various routes towards the sea.

2nd.—That the courses of these ancient glaciers corresponded in a general way with the present channels of drainage. The direction of the glacial furrows proves that one of these ice rivers flowed from Lake Huron, along a channel now filled with drift, and known to be at least one hundred and fifty feet deep, into Lake Erie, which was then not a lake, but an excavated valley into which the streams of Northern Ohio flowed, one hundred feet or more below the present lake level. Following the line of the major axis of Lake Erie to near its eastern extremity, here turning northeast, this glacier passed through some channel on the Cana-

dian side, now filled up, into Lake Ontario, and thence found its way to the sea either by the St. Lawrence or by the Mohawk and Hudson. Another glacier occupied the bed of Lake Michigan, having an outlet southward through a channel—now concealed by the heavy beds of drift which occupy the surface about the south end of the lake—passing near Bloomington, Illinois, and by some route yet unknown reaching the trough of the Mississippi, which was then much deeper than at present.

3D.—At this period the continent must have been several hundred feet higher than now, as is proved by the deeply excavated channels of the Columbia, Golden Gate, Mississippi, Hudson, etc., which could never have been cut by the streams that now occupy them, unless flowing with greater rapidity and at a lower level than they now do.

The depth of the trough of the Hudson is not known, but it is plainly a channel of erosion, now submerged and become an arm of the sea. As has been before stated this channel is marked on the sea-bottom for a long distance from the coast and far beyond a point where the present river could exert any erosive action, and hence it is a record of a period when the Atlantic coast was several hundred feet higher than now.

The lower Mississippi bears unmistakable evidence of being—if one may be permitted the paradox—a half-drowned river; that is, its old channel is deeply submerged and silted up, so that the "father of waters," lifted above the walls that formerly restrained him, now wanders, lawless and ungovernable, whither he will in the broad valley.

The thickness of the delta deposits at New Orleans is variously reported from fifteen hundred feet upwards, the discrepancies being due to the difficulty of distinguishing the alluvial clays from those of the underlying Cretaceous and Tertiary formations. It is certain, however, that the bottom of the ancient channel of the Mississippi has never been reached between New Orleans and Cairo; the instances cited

by Humphreys and Abbot in their splendid study of this river being but repetitions of the phenomena exhibited at the falls of the Ohio—the river running over *one side* of its ancient bed.

The trough of the Mississippi is not due to synclinal structure in the underlying rocks, but is a valley of erosion simply. Ever since the elevation of the Alleghanies—*i.e.* the close of the Carboniferous period—it has been traversed by a river which drained the area from which flow the upper Mississippi, the Ohio, the Tennessee, etc. Since the Miocene period, the Missouri, Arkansas, and Red rivers have made their contributions to the flood that flowed through it. The depth to which this channel is cut in the rock proves that at times the river must have flowed at a lower level and with a more rapid current than now; while the Tertiary beds formed as high as Iowa and Indiana in this trough, and the more modern Drift clays and boulders which partially fill the old rock cuttings, show that the mouth and delta of the river have, in the alternations of continental elevation, travelled up and down the trough at least a thousand miles; and that not only is it true, as asserted by Ellet, that every mile between Cairo and New Orleans once held the river's mouth, but that in the several advances and recessions of the waters of the Gulf the mouth has been more than twice at each point. The change of place of the delta has been caused, however, for the most part, by oscillations of the sea level, and not, as Ellet supposed, by the filling of the channel by the materials transported by the river itself.

DRIFT DEPOSITS. The Drift deposits which cover the glacial surface, consisting of fine clays below, sands and gravel above, large transported boulders on the surface, and the series of lake ridges (beaches) over all, form a sequence of phenomena of which the history is easily read.

Erie Clays. The lower series of blue or red clays—the "Erie clays" of Sir William Logan—over a very large area, rest directly on the plain and polished rock surfaces. These

clays are often accurately stratified, were apparently deposited in deep and generally quiet water, and mark a period when the glacial ice-masses, melted by a change of climate, retreated northward, leaving large bodies of cold fresh-water* about their southern margins, in which the mud produced by their grinding action on the paleozoic rocks of the Lake District was first suspended and then deposited.

On the shores of Lake Erie these clays contain no boulders and very few pebbles, while farther North and West boulders are more abundant. This is precisely what might be expected from the known action of glacial masses on the surfaces over which they pass. Their legitimate work is to grind to powder the rock on which they rest; an effect largely due to the sand which gathers under them, acting as emery on a lead wheel. The water flowing from beneath glaciers is always milky and turbid from this cause. Rocks and boulders are sometimes frozen into glaciers, and thus transported by them, but nearly all the boulders carried along by a glacier are such as have fallen from above; and a moraine can hardly be formed by a glacier except when there are cliffs and pinnacles along its course.

In a nearly level country, composed of sedimentary rocks passed over by a glacier, we should have very little débris produced by it, except the mud flour which it grinds.

The Erie clays would necessarily receive any gravel or stones which had been frozen into the ice, either as scattered pebbles or stones, distributed to some distance from the glacial mass by floating fragments of ice, or as masses of frozen gravel, or larger and more numerous boulders near the glacier. In some localities torrents would pour from the sides and from beneath the glacier, so that here coarse material would alone resist the rapid motion of the water, and the stratification of the sediments would be more or less confused.

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* *Cold*, because coming from the melting glacier, and depositing with its sediments no evidences of life; *fresh*, because no marine shells are found in it — only drift-wood — while the equivalent "Champlain" clays on the coast are full of Marine Arctic shells.

In regard to the *cause* of the gradual amelioration of the climate of the glacial epoch, by which the great glaciers of the lake basin were driven northward and finally altogether dissolved, we are not left entirely to conjecture.

Cosmical causes possibly and probably had the chief agency in producing this result, but we have unmistakable evidence of at least the coöperation of another and perhaps no less potent cause, namely, continental depression.

If a cosmical cause had simply increased the annual temperature till the glaciers were all melted, without the action of any other agent, we should never have had the accumulation of drift deposits which now occupy all the glacial area; but the drainage streams, changed in all their courses from ice to water, would have flowed freely and rapidly away through their deeply cut channels to deposit their abundant sediments only where their transporting power was arrested, in the depths of the ocean.

Instead of this, we everywhere find evidence that this flow was checked, and a basin of quiet water formed by an advance of the ocean consequent upon a subsidence of the land. On the Atlantic and Gulf coasts this depression progressed until the sea level was more than five hundred feet higher than now. The effect of this depression was to deeply submerge the eastern margin of the continent, and cover it with the "Champlain" clays.

It is evident that at this period the drainage from the great water-shed of the continent must have been met by the quiet waters of the ocean almost at the sources of the present draining streams, and as the "dead water" gradually crept up the valleys, arresting the transporting power of their currents, their old channels would be silted up and obliterated, and their valleys partially filled with materials for their subsequent terraces. In the advance and subsequent recession of the line of "dead water" we have ample cause for all our terrace phenomena.

This continental depression accounts satisfactorily for the

filling of the old channels of the Mississippi and the Ohio, as a depression of five hundred feet would bring the ocean nearly to Pittsburgh on the Ohio, to St. Paul on the Mississippi.

But I think we have evidence that the continent did not sink uniformly in all its parts, but *most at the North.* Not to cite any other proof of this,—northern coast fiords, etc. —the altitude of the loess-like deposits of the upper Mississippi and Missouri (the lacustrine non-glacial sediments of this period of submergence), the upward reach of the Drift clays of the lake basin, the filling of the valleys of the streams flowing into the Ohio and Lake Erie, the old lake beaches marking the former water-level in the lake basin—all indicate that the continental subsidence was greatest towards the north. To this subsidence we must, as I think, attribute the accumulation of water in the lake basin and Mississippi valley to form the great inland sea of fresh-water, of which traces everywhere abound. It seems to me scarcely necessary to suppose any other barriers by which this sea was enclosed than the highlands that encircle it—such as are roughly outlined by the light tint on Professor Guyot's map of North America—and the sea-water which filled the mouths of the two* straits by which it communicated with the ocean.

Yellow Sands and Surface Boulders. I have mentioned that on the Erie clays are beds of gravel, sand, and clay, and over these again great numbers of transported boulders, often of large size and of northern and remote origin.

These surface deposits have been frequently referred to as the direct and normal product of glacial action, the materials torn up and scraped off by the great ice ploughs in their

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*If there *were* two. That there was one in the course of the Mississippi we know, and that so long that, though salt at one end, it must have been fresh at the other.

The eastern outlet of the lake waters may not have been by the St. Lawrence but as likely through the gap between the Adirondacks and the Alleghanies. The shallow channels between the Thousand Islands and the Lachine Rapids seem to indicate that the St. Lawrence is a comparatively *new* line of drainage for the lakes.

long journeys from the North; in fact, as some sort of huge terminal and lateral moraines. I have, however, disproved, as I think, this theory of their transportation in a paper published some years since (Notes on the Surface Geology of the Basin of the Great Lakes. Proc. Bost. Nat. Hist. Soc. 1863), in which it is urged that the continuous sheet of the Erie clays upon which they rest, and which forms an unbroken belt between them and their place of origin, precludes the idea that they have been transported by any ice-current or rush of water moving over the glacial surface; as either of these must have torn up and scattered the soft clays below.

There is, indeed, no other conclusion deducible from the facts than that these sands, gravels, granite and greenstone boulders—masses of native copper, etc., which compose the superficial Drift deposits—have been *floated* to their resting-places, and that the floating agent has been ice, in the form of *icebergs;* in short, that these materials have been transported and scattered over the bottom and along the south shore of our ancient inland sea, just as similar materials are now being scattered over the banks and shores of Newfoundland.

If we restore in imagination this inland sea, which we have proved once filled the basin of the lakes, gradually displacing the retreating glaciers, we are inevitably led to a time in the history of this region when the southern shore of this sea was formed by the highlands of Ohio, etc., the northern shore a wall of ice resting on the hills of crystalline and trappean rocks about Lake Superior and Lake Huron.

From this ice-wall masses must from time to time have been detached,—just as they are now detached from the Humboldt Glacier,—and floated off southward with the current, bearing in their grasp sand, gravel, and boulders—whatever composed the beach from which they sailed. Five hundred miles south they grounded upon the southern shore; the highlands of now Western New York, Pennsylvania and

Ohio, or the shallows of the prairie region of Indiana, Illinois, and Iowa; there melting away and depositing their entire loads,—as I have sometimes seen them, a thousand or more boulders on a few acres, resting on the Erie clays and looking in the distance like flocks of sheep,—or dropping here and there a stone and floating on, east or west, till wholly dissipated.

These boulders include representatives of nearly all the rocks of the Lake Superior country, conspicuous among which are granites with rose-colored orthoclase, gray gneiss, and diorites, all characteristic of the Laurentian series; hornblendic rocks, massive or schistose, and dark greenish or bluish silicious slates, probably from the Huronian; dolorites and masses of native copper, apparently from the Keweenaw Point copper region.

In the Drift gravels I have found pebbles and small boulders of nearly all the paleozoic rocks of the lake basin, containing their characteristic fossils, namely, the Calciferous Sandrock with *Maclurea*, Trenton and Hudson with *Ambonychia radiata*, *Cyrtolites ornatus*, Medina with *Pleurotomaria litorea*, Corniferous with *Conocardium trigonale*, *Atrypa reticularis*, *Favosites polymorpha*, Hamilton with *Spirifer mucronatus*, etc.

The granite boulders are often of large size, sometimes six feet and more in diameter, and generally rounded.

The largest transported blocks I have seen are the more or less angular masses of corniferous limestone mentioned on a preceding page.

Along the southern margin of the Drift area, especially on the slopes of the highlands of Northern Ohio, the Drift sands and gravels are of considerable thickness, forming hills of one hundred feet or more in height, generally stratified, but often without any visible arrangement. These deposits are very unevenly distributed, with a rolling surface frequently forming local basins, which hold the little lakelets or sphagnous marshes so characteristic of the region referred

to. These are the beds to which I have alluded as constituting, in the opinion of some geologists, a great glacial moraine, but from the fact that they are locally stratified, and overlie the older blue clays, I have regarded them as transported not by glaciers, but by icebergs.

Possibly some part of this Drift material may have accumulated along the margin of the great glacier, moved by its agency; but in that case we should expect to find in it abundant fragments of the rocks which outcrop in the region under consideration, whereas I have rarely, if ever, seen in these Drift gravels any representatives of the rocks underlying the south margin of the lake basin.

By whatever agency transported, the Drift gravels have, like the boulders, for the most part come from some remote point at the North, and were once spread broadcast along the southern shore of the inland iceberg-bearing sea.

In the retreat of the shore line during the contraction of the water surface down to its present area, every part of the slope of the southern shore between the present water surface and the highest lake level of former times, *i.e.* all within a vertical height of three hundred feet or more, must in turn have been submitted to the action of the shore waves, rain, and rivers, by which if, as is probable, the retrograde movement of the water line was slow, these loose materials would be rolled, ground, sorted, sifted, and shifted, so that comparatively little would be left in its original bedding; the fine materials, clay and sand, would be washed out and carried farther and still farther into the lake basin, and spread over the bottom, to form, in short, the upper sandy layers of the Drift.

At certain points in its descent the water level seems to have been for a time stationary, and such points are marked by terraces and the long lines of ancient beaches which have been referred to. A similar "lake ridge" now borders the south shore of Lake Michigan, where it may be observed in the process of formation; and this seems to be the legitimate

effect of waves everywhere on a sloping shore composed of loose material; storms driving up sand and gravel to form a ridge which ultimately acts as a barrier to the waves that built it. Winds, also, often assist in building up, and sometimes alone form these ridges, by transporting inland the beach sand.

In other localities, where hard rock masses formed the shore of our inland sea, perpendicular wave-worn cliffs were produced; and many of these now stand as enduring and indisputable monuments of a sea whose waves, perhaps for ages, beat against them. Such cliffs may be observed on Little Mountain, in Lake county, in the valley of the Cuyahoga, in Medina and Lorain county, Ohio, along the outcrops of the Carboniferous conglomerate and Waverly sandstone.

In all the changes through which the valley of the Mississippi passed during the "Drift Period," its general structure and main topographical features remained the same. Yet the character of its surface suffered very important modifications, and such as deeply affected its fitness for human occupation.

As we have seen, the glacial epoch was marked by erosion on a grand scale.

Then, our river valleys and some of our lakes—though mapped out long before—were excavated to a much greater depth than they now have.

During their subsequent submergence, these valleys and lakes were partially or perfectly filled with the drift deposits which covered all the surface like a deep fall of snow, rounded its outlines and softened all its asperities.

When the waters were withdrawn, the rivers again began clearing their obstructed channels; a work not yet accomplished, and in many instances not half done. Numbers of the old channels were wholly filled and obliterated, and the streams that once traversed them were compelled to find quarters elsewhere. Examples of this kind have been already cited, and they could be multiplied indefinitely.

ORIGIN OF THE GREAT LAKES.—The question of the origin of our lakes is one that requires more observation and study than have yet been given to it before we can be said to have solved all the problems it involves. There are, however, certain facts connected with the structure of the lake basins, and some deductions from these facts, which may be regarded as steps already taken toward the full understanding of the subject. These facts and deductions are briefly as follows:—

1st. Lake Superior lies in a synclinal trough, and its mode of formation therefore hardly admits of question, though its sides are deeply scored with ice-marks, and its form and area may have been somewhat modified by this agent.

2d. Lake Huron, Lake Michigan, Lake Erie, and Lake Ontario are excavated basins, wrought out of once continuous sheets of sedimentary strata by a mechanical agent, and that ice or water, or both.

That they have been filled with ice, and that this ice formed great moving glaciers we may consider proved. The west end of Lake Erie may be said to be carved out of the Corniferous limestone by ice action; as its bottom and sides and islands—horizontal, vertical, and even overhanging surfaces—are all furrowed by glacial grooves, which are parallel with the major axis of the lake.

All our great lakes are probably very ancient, as since the close of the Devonian period the area they occupy has never been submerged beneath the ocean, and their formation may have begun during the Coal Measure epoch.

The Laurentian belt, which stretches from Labrador to the Lake of the Woods, and thence northward to the Arctic sea, forms the oldest known portion of the earth's surface. The shores of this ancient continent, then high and mountainous, were washed by the Silurian sea, where the débris of the land was deposited in strata that subsequently rose to the surface, and formed a broad low margin to the central mountain belt, just as the Cretaceous and Tertiary strata flank the Alleghanies in the Southern States.

In the lapse of countless ages, all the mountain peaks and chains of the Laurentian continents have been removed and carried into the sea, and this has been done by rivers of water and rivers of ice. That these mountains once existed there can be no reasonable doubt, for their truncated bases remain as witnesses, and it is scarcely less certain that glaciers have flowed down their slopes of sufficient magnitude and reach to deeply score the plain which encircled them.

It will be noticed that all the great lakes of the continent hold certain relations to the curving belt of Laurentian highlands.

Some of them are embraced in the foldings of the Eozoic rocks, and fill synclinal troughs; but most of the series, from Great Bear Lake to Lake Ontario, exhibit the same geological and physical structure, are basins of excavation in the paleozoic plain that flanks in a parallel belt the Laurentian area. Few of us have any conception of the enormous general and local erosion which that plain has suffered. Those who will take the trouble to examine the section across Lake Ontario, from the Alleghanies to the Laurentian hills of Canada, and compare it with the other sections in the Lake Winnepeg district, radial to the Laurentian arch, given by Mr. Hind in his report on the Assiniboin country, will be sure to find the comparison interesting and suggestive; suggestive especially of a community of structure and history, and of an inseparable connection between the lake phenomena and the topographical features of the Laurentian highlands flanked by the paleozoic plain.

In estimating the influences that might have affected the number and magnitude of glaciers on the sides of the Laurentian mountains, it should not be forgotten that the Cretaceous sea swept the western shore of the Paleozoic and Laurentian continent from the Gulf of Mexico to the Arctic Ocean; and whether we consider this sea as a broad expanse of water simply dotted with islands, or a strait traversed by a tropical current, we have in either case conditions peculi-

arly favorable to the formation of great glacial masses of ice, *i. e.* a broad evaporating surface of warm water swept by westerly winds that carried all suspended moisture immediately on to a mountain belt, which served as a sufficient condenser.

This, at least, may be positively asserted in regard to the agency of ice in the excavation of the lake basins, that their bottoms and sides wherever exposed to observation, if composed of resistant materials, bear indisputable evidence of ice action, proving that these basins were filled by moving glaciers in the last ice period if never before, and that part, at least, of the erosion by which they were formed is due to these glaciers.

No other agent than glacial ice, as it seems to me is capable of excavating broad, deep, boat-shaped basins, like those which hold our lakes.

If the elevation of temperature and retreat northward of the glaciers of the lake basins were not uniform and continuous, but alternated with periods of repose, we should find these periods marked by excavated basins, each of which would serve to measure the reach of the glacier at the time of its formation, the lowest basin being the oldest, the others formed in succession afterwards. Such a cause would be sufficient to account for any local expansions of the troughs of the old ice rivers.

Where glaciers flow down from highlands on to a plain or into the sea, the excavating action of the ice mass must terminate somewhat abruptly in the formation of a basin-like cavity, beyond which would be a rim of rock, with whatever of débris the glacier has brought down to form a terminal moraine.

When glaciers reach the sea, the great weight of the ice mass must plough up the sea bottom out to the point where the greater gravity of water lifts the ice from its bed, and bears it away as an iceberg.

If it is true, as the facts I have cited indicate, that our

lakes are but portions of great excavated channels locally filled with drift material, the fiords of the northern Atlantic and Pacific coast present remarkable parallels to them; and I would suggest Puget's Sound, Hood's Canal, and other portions of that wonderful system of navigable channels about Vancouver's Island, as affording interesting and instructive subjects for comparison. Like our lakes their channels are for the most part excavated from sedimentary strata which form a low and comparatively level margin to the bases of mountain chains and peaks. They too have their depths and shallows, their basins and bars, and probably all who have seen them will assent to Professor Dana's view, that they are the "result of subaërial excavation," in which glaciers performed an important part.

The "Loess" of the Mississippi Valley. The "Bluff formation" of the West, sometimes called "Loess," from its resemblance to the Loess of the Rhine, I have on a preceding page designated as a lacustrine non-glacial Drift deposit. It seems to be the sediment precipitated from the waters of our great inland sea in its shallow and more quiet portions, to which icebergs, with their gravel and boulders, had no access, and where the glacial mud was represented only by an impalpable powder, which mingled with the wash of the adjacent land, land shells, etc.

It is evidently one of the most recent of the deposits which come into the series of Drift phenomena, and was apparently thrown down while the broad water surface which once stretched over the region where it is found was narrowing by drainage and evaporation, till, by its total disappearance, this sheet of calcareous mud was left.

It underlies much of the prairie region, and once filled, often to the brim, the troughs of the Mississippi and Missouri, so deeply excavated during the glacial epoch. When the system of drainage was re-established the new rivers began the excavation of their ancient valleys in the Loess. When they had cut into or through this stratum, so that it

stood up in escarpments on either side, man came and called it the *Bluff* formation, because it composed or capped the bold bluffs of the river-banks. It is often, however, only a facing to the rocky cliffs, which are the true walls of these valleys, and which are monuments of an age long anterior to the date of its deposition.—*Annals of the Lyceum of Natural History of New York*, 1869.

OUR NATIVE TREES AND SHRUBS.

BY REV. J. W. CHICKERING, JR.

It has long been a favorite aspiration of the writer, at some time in life, to have an arboretum collected from our woods and waysides. But despairing of that, I would in this article give a list of those native shrubs and trees, which seem to promise to repay transplanting, and which would in beauty, and many of them in novelty, to any but the botanist, vie with those imported.

Of the trees of early spring, it is a pity that the Silver Maple (*Acer dasycarpum*), and the Sugar Maple (*A. saccharinum*), were not more generally known and valued, as *flowering* trees. The former is the earliest tree I know in this latitude, and the beauty of the long, yellow tassels of the latter, commends itself to every observer. Then for grounds of any extent the different Birches, the White (*Betula alba*), the Paper (*B. papyracea*), the Yellow (*B. excelsa*), and the Black (*B. lenta*), are in early spring most attractive ornaments, for the grace and variety of the spray of their delicate catkins. Then the Tulip Tree (*Liriodendron tulipifera*), and the Cucumber Tree (*Magnolia acuminata*), both perfectly hardy in New York and New England, should be seen much more frequently in cultivated grounds.

The Barberry (*Berberis vulgaris*) forms a pleasing clump

whether it hang out its bright yellow flowers or its crimson berries.

Of course the Sumachs would claim a place with their variety of flower, fruit and leaf, at least the Staghorn Sumach (*Rhus typhina*), with its red velvety branches; *R. glabra*, as smooth as the last is shaggy, and *R. copallina*, with its leaves looking as if varnished.

The New Jersey Tea (*Ceanothus Americanus*), with its spikes of delicate white flowers, demands a place, as well as admiration.

Bittersweet (*Celastrus scandens*), also called Roxbury Waxwork, so well known as having given a name to one of the most charming rural poems in our language, is a hardy climber, vigorous and luxuriant in summer, and very conspicuous in autumn, with its scarlet seed coverings set in orange linings, as is its first cousin the Waahoo (*Euonymus atropurpureus*), with its crimson drooping fruit, not uncommon in cultivation.

The Red-bud, or Judas Tree (*Cercis Canadensis*), with its branches all aflame in early spring, is a small, graceful tree.

Spiræa opulifolia, is an attractive variety, while the Meadow Sweet (*S. salicifolia*), and the Hardhack (*S. tomentosa*), so valuable as a medicine, were they only less common, would be eagerly sought for their beauty.

The Shad-bush (*Amelanchier Canadensis*), heralding along the Connecticut, "the first run of shad," is a favorite where-ever known, while the Witch Hazel (*Hamamelis Virginica*), closing the floral procession of the season with its weird, wrinkled yellow flowers in October, and even November, is not to be neglected.

The Flowering Dogwood (*Cornus florida*), beautiful alike in its snowy profusion of flowers and its bright red berries, is less known and far less cultivated than its merits deserve. It is hardy, with bright green leaves, and ought to become common, as our most showy shrub or small tree.

Several other species of this genus are worthy a place in our collections: *Cornus circinata*, *sericea*, *stolonifera*, *paniculata*, *alternifolia*, all of which may be found either in thickets or swampy places.

The Honeysuckle family is already introduced, but some members of it need a special introduction.

The Snowberry (*Symphoricarpus racemosus*), with its fruit so well known to children as far from liability to stain; and the Coral-berry (*S. vulgaris*), are in general cultivation, especially the former.

The Trumpet Honeysuckle (*Lonicera semperivirens*), and the delicate little Fly Honeysuckles (*L. ciliata* and *cœrulea*), are equally as charming as some of their foreign sisters. The *Viburnum* too is a beautiful genus. The Cranberry Tree (*V. Opulus*), whose fruit is better to look at than to eat, and the Hobble-bush (*V. lantanoides*), so called from the facility with which its procumbent branches trip the incautious traveller, are well known in early spring, with their broad cymes of mainly sterile flowers; and the flower-buds of the latter forming in early autumn, afford a beautiful study of nature's care in affording protection against the winter's cold; while the rusty down upon the leaf-stalks affords under the microscope a most beautiful specimen of stellate hairs. But the other species, *V. nudum*, *prunifolium*, *dentatum*, *pubescens*, *acerifolium*, and especially *Lentago*, while by no means rare in the woods and copses, are very beautiful, with enough of variety to render it desirable to have them all.

The Button-bush (*Cephalanthus occidentalis*) is odd, with its buttons of white flowers, and worthy of cultivation.

Many of the *Ericacœ* are no less beautiful than unknown. The Swamp Blueberry (*Vaccinium corymbosum*) with its great variety of forms, is a very attractive shrub, with pubescent leaves, large flowers, and conspicuous and delicious fruit. The Deerberry (*V. stamineum*) is very peculiar in its habit of flowering, and would be very ornamental. Doubt-

less this genus will eventually be taken up by the nurserymen, as have the different species of Rubus.

The Leather Leaf (*Cassandra calyculata*), and *Andromeda polifolia*, are both worthy of attention. White Alder (*Clethra alnifolia*) is already somewhat known, and is covered in August with handsome blossoms so fragrant that a clump may be detected at many rods distance.

Mountain Laurel, Calico-bush, Spoon-wood (*Kalmia latifolia*), is one of the most beautiful shrubs ever created, as seen in profusion in its varying shades, in parts of Massachusetts, but very seldom in cultivation. *Kalmia glauca*, or Pale Laurel, is less showy, but of great beauty. The Azaleas (*A. viscosa* and *nudiflora*) are very common, very beautiful and fragrant, but very seldom cultivated.

The Great Laurel (*Rhododendron maximum*), though magnificent in its native thickets, cannot probably compete with the foreign species, now so generally introduced, but *Rhodora Canadensis*, with its rose-purple blossoms, covering the leafless branches, is one of the pleasantest sights of early spring, and Labrador Tea (*Ledum latifolium*) with its delicate white clusters and leaves rusty-woolly beneath, is likewise full of beauty.

The Fringe-tree (*Chionanthus Virginica*) with its delicate white drooping panicles, ought to be seen much more frequently than it is.

Sassafras officicinale with its curiously lobed leaves, yellow racemes of flowers, and spicy aroma; Leather-wood (*Dirca palustris*), also called Wicopy, with pale yellowish flowers is a curious shrub, its wood soft and brittle, its bark so tough that it can be used for thongs, requiring a strong man to break even its slenderest twigs.

From this list have been omitted very many trees and shrubs in common cultivation. The object has been to call attention to those less generally known. Many of these have their natural station in swampy ground; many resist attempts at transplanting. But a little care in choosing from

those in dryer locations, or setting out in moist ground, or better yet, propagating from seed, would doubtless overcome these difficulties, reward the pains taken, and introduce some charming novelties to the lovers of flowers.

Such an arboretum, shrubbery or lawn, comprising only native species, would not only gratify the botanist and the naturalist, but would surprise and delight the rapidly increasing number of amateur cultivators, who as yet have very little idea of the wealth of floral beauty to be found in our swamps and woodlands.

A WINTER'S DAY IN THE YUKON TERRITORY.

BY W. H. DALL.

MANY of the readers of the NATURALIST when they hear Alaska spoken of, picture to themselves a snow-covered country, with at most a scanty summer, and a long and extremely cold winter. A recent "official" report for instance, represents the island of St. Paul as surrounded in winter by "immense masses of ice" on which the polar bears and arctic foxes sail down from the North and engage in pitched battle with the wretched inhabitants. Such romances are due solely to the ardent imagination of the "official" mind, and have no basis in fact. There is no solid, and but little floating ice near St. Paul in winter; the arctic foxes found there as well as on most of the other islands, were purposely introduced by the Russians for propagation, a certain number of skins being taken annually; and finally, we have no authentic evidence that the polar bear has ever been found south of Behring Strait.

The country of Alaska comprises two climatic regions which differ as widely as Labrador and South Carolina in their winter temperature. One contains the mainland north

of the peninsula of Aliaska and the islands north of the St. Matthew group. The other includes the coast and islands south and east of Kadiak, while the Aleutian Islands, with the group of St. Paul and St. George, are somewhat intermediate, being nearly as warm as the southern or Sitkan district, and much less rainy.

This article will refer only to the northern district, which I have called the Yukon Territory. This is the coldest and most inhospitable part of the country, yet it is far from resembling Labrador or Greenland, although the winter weather may occasionally be very cold. The summers are much warmer and more pleasant than in Labrador, and may be compared to those of the Red River district of the Hudson Bay Territory.

At the first thought one would hardly suppose that a naturalist would find much to do in the depth of winter, unless it were to sit by his great Russian oven or stove, and keep himself warm. I would invite the readers of the NATURALIST to accompany me on a day's tramp, similar to many which I have undertaken without such pleasant company, and see how far their first anticipations will be realized.

We will start from Ulokuk, an Indian village on the portage between the Yukon and Norton Sound, and bring up at Unaloklik, an Eskimo village on the coast, thirty miles away.

We clothe ourselves in the comfortable costume of the country, consisting of a pair of warm American trousers; a deerskin hunting shirt with a hood, made with the hair on, trimmed with wolf or wolverine skin, and fastened by a belt around the waist; a good mink-skin cap with ear-lappets; a pair of otter-skin mittens; and a pair of long Indian deerskin boots with soles of sealskin, tied around the ankle and just below the knee, and having a bunch of straw below the foot to keep it warm, dry, and safe from contusions. Our equipment will consist of our guns, a geological hammer, a good sheath-knife, a small axe, teakettle, bag of biscuit and dry salmon, and a pair of long snowshoes apiece.

We start at ten o'clock, just as the December sun emerges from the southern hills and casts its welcome beams over the broad tundra covered with snow, flecking the green spruce boughs with golden touches of light, and giving a mellow tone to the clear blue sky. The temperature may be about twenty below zero, but in our warm deerskin dresses, we feel that it is only just cold enough to make the blood leap and the nerves thrill with the excitement of a brisk walk, skimming over the snow with our light snowshoes.

We just clear the alder bushes around the village when a chirp and twitter in a clump of willows attract our attention. We look, and see a flock of the Pine Grosbeaks (*Pinicola enucleator*), brilliant in scarlet and yellow, rifling the willows of their buds, carefully rejecting the scales and eating only the tender green hearts of the young buds. They look so pretty as they ruffle their scarlet coats, defying the winter frost, fat and comfortable with abundance of food, that we hesitate before we bring our guns to bear on them, and reluctantly add half a dozen members of the happy family to our collecting bag, with a single shot. They have the large bill which has been thought to distinguish the European form alone, and cannot be distinguished from typical specimens of the *enucleator*. They are among the most common of the Yukon birds in winter, and though quite small are usually fat and tender, and not to be despised in a pie. Leaving the banks of the Ulokuk River we strike across an undulating prairie called *tundra* by the Russians, and only marked by clumps of dwarf willow (*Salix Richardsonii*), which project above the snow. Here and there a larch shakes its myriads of little cones in the passing breeze, or a small spruce shows its green tips; but the large spruce, poplar, willow and birch, prefer the vicinity of the river. The snow-covered Ulokuk Hills smooth, serene and beautiful, bear up the reluctant sun, which seems loth to part from the horizon. Does the snow move? or what is that by yonder willow brush? We are answered as a covey of the exquisite

Snow Grouse or Ptarmigan (*Lagopus albus*) rise with a whirr, showing their black tail-feathers as they seek a more retired spot. Scarcely to be distinguished from the snow, nor less immaculate, we must be more sharply on the lookout if we would secure a brace next time. They are better to look at than to eat; for the dark colored flesh is dry and tasteless, and if we want specimens the better plan is to apply to the next Indian girl we meet. She, for a needle apiece, will furnish us with birds caught in snares, without a feather ruffled, or a speck on their shining coats. Their legs and feet are feathered down to the toes, and other stockings would be superfluous were we ourselves so warmly clad.

As we near a clump of poplars on a bend in the river, we see that the bushes are alive with tiny birds. The Black Cap (*Parus atricapillus*) and the Hudson Bay Titmouse (*P. Hudsonicus*), chatter to each other from the swaying twigs of alder, and a little farther on is a countless flock of the Rosy Crowned Sparrow (*Ægiothus linaria*) bold and saucy, with their crimson crests and rosy bosoms setting off their graceful shapes and lively motions.

Chip! chip! chee! cries an angry Squirrel (*Sciurus Hudsonius*) from yonder poplar; he evidently wants to know why we intrude on his privacy with guns and things, making ourselves disagreeable. A look, and he darts behind the trunk, only showing his head and ears, repeating his angry cry in apparent astonishment at our obstinacy in remaining. Finding us unmoved "a change comes o'er the spirit of his dreams" and he seeks refuge in the deserted nest of a Golden-winged Woodpecker (*Colaptes auratus*), and waits for better times. You ask what is yonder broad trail in the snow; too small for a bear, too broad and heavy for a fox. It is the track of a Wolverine (*Gulo luscus*), known here by the more euphonic name of *rossamorga*. The Indians tell strange stories of his cunning, his perseverence in destroying their traps, and his almost human powers of reflection. The

Hudson Bay men say the same, but between you and I, I don't believe half of it. Mr. Carcajou is very intelligent, no doubt, but he takes the place of snakes in the legends of the northern trapper, and we all know what stories are told about snakes, in more southern latitudes.

The sun, though very low, is at his noonday elevation, and a short time will be devoted with satisfaction to lunch. One takes the axe and starts for a dead dry spruce tree, another scrapes away the snow from a hillock, with his snowshoe. There we see in the depth of winter bright green mosses and other small plants, with the partridge berry and cranberry vines loaded with berries beneath the snow. The white fleecy covering defends them from the frost, and when the snow melts in the spring they have only to put forth their blossoms and continue to grow, under the warm sun which endures almost till midnight in May and June.

Here comes the wood, and we proceed to make a white man's fire, which is built with the sticks laid parallel in layers which are at right angles to one another. This makes a flat top, and taking a dry stick we whittle a few shavings, which are put on top of the pile. Then with a flint and steel (for matches are luxuries in the Yukon Territory) we light a bit of punk, and with our breath as a bellows, in a few moments we have a light with which we proceed to kindle the fire, putting it on top of the pile, so that the air having free access, it soon produces a cheerful blaze. An Indian builds his fire conically, which is much less convenient and takes much longer to boil the kettle. It is a work of time and difficulty to melt enough snow to fill the teakettle, and taking the axe, we go yonder where a low, smooth depression in the snow indicates the position of what was a pool of water. A few minutes vigorous chopping and the welcome fluid gushes up and rapidly overflows the surface of the ice where we have scraped away the snow. It is full of little red crustaceans, like sand fleas, etc., among which we may distinguish members of the genus Cyclops, giants of their

kind, carrying two pear-shaped bunches of eggs, one on each side of the tail. We throw a double handful of snow into the hole to filter out these unbidden guests, and filling the teakettle return to the bivouac where the others are broiling pieces of dry salmon on sticks by the fire. As soon as the kettle boils we put in the tea and let it boil up once, and our meal is ready. Tin cups in hand, we enjoy the grateful and refreshing beverage, which is worth more to the traveller in the north than any amount of whiskey. Indeed the latter is worse than worthless, and no old traveller would wish to have it along with him. After tea, biscuit and salmon are discussed, the one other luxury of voyageur life is enjoyed, namely, a cheerful pipe of tobacco, and replacing our pipes in our "fire-bags" we continue on our way. By keeping a sharp lookout it is more than probable that we shall see a Marten (*Mustela Americana*) seeking refuge in some bushy spruce as we pass by. Their tracks are everywhere, and they often disturb the traveller's cache of dry salmon used for dog feed, and left by the roadside until his return.

We keep on our way through thick spruce groves where the trees may average eighteen inches in diameter and forty feet high. In the interior, on the Yukon, they grow much larger, but all the trees diminish in size and abundance as we approach the coast, where there are none at all. The Aspen (*Populus tremuloides*), the Spruce (*Abies alba*), the Poplar (*Populus balsamifera*), and the Birch (*Betula glandulosa*), are the largest and most prominent trees. There are no true pines, though the settlers call the spruce "pine." Leaving the bank as we reach the river we continue on our way upon the ice. Although the thermometer may have been as low as fifty below zero since August, yet you will always find open places in the ice. These are formed by the rapid current or by warm springs. At Ulokuk there are a number of the latter, which keep a large space in the river open all the year round. Over this water a cloud, like steam, arises

in very cold weather. Myriads of fish, particularly a delicious salmon-trout, and a small cyprinoid fish, frequent such localities. One would hardly look for insects in this winter weather, yet by watching the snow on the river while the sun shines brightly, a small, shining, pointed creature, like a *Podura*, may be seen gliding between the particles of snow, and immediately disappearing should a cloud pass over the sun. In September I have found wooly caterpillars, the larvæ of *arctians*, crawling on the snow, while the atmosphere was even below zero; and I once found (October 20th) the caterpillar of *Vanessa Antiopa* in the same manner, alive; and on yet another occasion I shot a whiskey jack, or Canada jay (*Perisoreus Canadensis*), with one just killed, in his mouth. A little way farther on, a bluff of dark colored sandstone fronts the river. Here our hammers may well be employed, and with care fine specimens of fossil leaves may be obtained. These are usually Sycamores (*Platanus*), but others can be found by searching for them, and in Cook's Inlet some fifty species have been collected, some of which are common to Greenland, Spitzbergen, Northern Europe and Siberia, showing that there was a time when this part of the world was covered with a rich and verdant forest, and the temperature was about that of Virginia. This was before the advent of the hairy elephant, who lived in colder times. It grew at last too cold for him, however, and his bones and teeth may be found scattered over the country, on the surface, and usually much decayed. His remains have been found imbedded in the masses of ice (not glaciers) which fringe the Siberian coasts, and in a perfect state of preservation, as if he had wandered into an enormous refrigerator and been frozen into it.

You will look in vain here for the familiar drift boulders, so common in the stone fences of New England. What was going on during the glacial period in the Yukon Territory is a mystery. There were no glaciers there, for their traces are entirely wanting.

The sun is now on the point of retiring for the night, although it is barely three o'clock, and the sight of the tall caches, like corncribs, which mark the position of the village for which we are bound, is not unwelcome; for thirty miles on snowshoes is a good day's tramp, especially for the first time. In a few minutes we are seated in one of the comfortable underground houses and enjoying the hospitality of the friendly Eskimo. Perhaps some summer's day, reader, we will try our luck together again.

A FEW WORDS ABOUT MOTHS.

BY A. S. PACKARD, JR.

The opportunity of copying a number of colored figures by Abbot, hitherto unpublished, leads me to say a few words regarding our native moths. The Lepidoptera, both butterflies and moths (especially the former, from their constant presence by day) from their beauty and grace, have always been the favorites among amateur entomologists, and the rarest and most costly works have been published in which their forms and gorgeous colors are represented in the best style of natural history art. We need only mention the folio volume of Madam Merian of the last century, Harris's Aurelian, the works of Cramer, Stoll, Drury, Hübner, Horsfield, Doubleday and Westwood, and several others, as comprising the most luxurious and costly entomological works.

Near the close of the last century, John Abbot went from London and spent several years in Georgia, rearing the larger and more showy butterflies and moths, and painting them in the larva, chrysalis and adult, or imago, stage. These drawings he sent to London to be sold. Many of them were collected by Sir James Edward Smith, and published under the title of "The Natural History of the Rarer Lepi-

dopterous Insects of Georgia, collected from the Observations of John Abbot, with the Plants on which they Feed." London, 1797. 2 vols., fol. Besides these two rare volumes there are sixteen folio volumes of drawings by Abbot in the Library of the British Museum. The plate given with this article is selected from a thick folio volume of similar drawings presented by Dr. J. E. Gray of the British Museum to Professor Asa Gray, to whose kindness we are indebted for an opportunity of figuring the transformations before unknown of over a dozen moths, whose names are given, as far as possible in the present state of our knowledge, in the explanation of the plate.

The study of insects possesses most of its interest when we observe their habits and transformations. Caterpillars are always to be found, and with a little practice are easy to raise, and we would advise any one desirous of beginning the study of insects to take up the butterflies and moths. They are perhaps easier to study than any other group of insects, and are more ornamental in the cabinet. As a scientific study we would recommend it to ladies as next to botany in interest and the ease in which specimens may be collected and examined. The example of Madam Merian, and several ladies in this country who have greatly aided science by their well filled cabinets, and thorough and critical knowledge of the various species and their transformations, is an earnest of what may be expected from their followers. Though the moths are easy to study compared with the bees, flies, beetles and bugs, and neuroptera, yet many questions of great interest in philosophical entomology have been answered by our knowledge of their structure and mode of growth. The great works of Herold on the evolution of a caterpillar; of Lyonet on the anatomy of the Cossus; of Newport on that of the Sphinx, both in their various stages; and of Siebold on the parthenogenesis of insects, especially of *Psyche helix*, are proofs that the moths have engaged some of the master minds in science.

The study of the transformations of the moths is also of great importance to one who would acquaint himself with the questions concerning the growth and metamorphosis and origin of animals. We should remember that the very words "metamorphosis" and "transformation," now so generally applied to other groups of animals and used in philosophical botany, were first suggested by those who observed that the moth and butterfly attain their maturity only by passing through wonderful changes of form and modes of life.

The knowledge of the fact that all animals pass through some sort of a metamorphosis is very recent in physiology. Moreover the fact that these morphological eras in the life of an individual animal accord most unerringly with the gradation of forms in the type of which it is a member, was the discovery of the eminent physiologist Von Baer. Up to this time the true significance of the luxuriance and diversity of larval forms had never seriously engaged the attention of systematists in entomology.

What can possibly be the meaning of all this putting on and taking off of caterpillar habilaments, or in other words, the process of moulting, with the frequent changes in ornamentation, and the seeming fastidiousness and queer fancies and strange conceits of these young and giddy insects seem hidden and mysterious to human observation. Indeed, few care to spend the time and trouble necessary to observe the insect through its transformations; and that done, if only the larva of the perfect insect can be identified and its form sketched how much was gained! A truthful and circumstantial biography in all its relations of a single insect has yet to be written.

We should also apply our knowledge of the larval forms of insects to the details of their classification into families and genera, constantly collating our knowledge of the early stages with the structural relations that accompany them in the perfect state.

The simple form of the caterpillar seems to be a concen-

tration of the characters of the perfect insect, and presents easy characters by which to distinguish the minor groups; and the relative rank of the higher divisions will only be definitely settled when their forms and methods of transformation are thoroughly known. Thus, for example, in two groups of the large Attacus-like moths, which are so amply illustrated in Dr. Harris's "Treatise on Insects Injurious to Vegetation;" if we take the different forms of the caterpillars of the Tau moth of Europe, which are figured by Godart and Duponchel, we find that the very young larva has four horn-like processes on the front, and four on the back part of the body. The full grown larva of the Regalis moth, of the Southern states, is very similarly ornamented. It is an embryonic form, and therefore inferior in rank to the Tau moth. Multiply these horns over the surface of the body, lessen their size, and crown them with hairs, and we have our Io moth, so destructive to corn. Now take off the hairs, elongating and thinning out the tubercles, and make up the loss by the increased size of the worm, and we have the caterpillar of our common Cecropia moth. Again, remove the naked tubercles almost wholly, smooth off the surface of the body, and contract its length, thus giving a greater convexity and angularity to the rings, and we have before us the larva of the stately Luna moth that tops this royal family. Here are certain criteria for placing these insects before our minds in the order that nature has placed them. We have here certain facts for determining which of these three insects is highest and which lowest in the scale, when we see the larva of the Luna moth throwing off successively the Io and Cecropia forms to take on its own higher features. So that there is a meaning in all this shifting of insect toggery.

This is but an example of the many ways in which both pleasure and mental profit may be realized from the thoughtful study of caterpillar life.

In collecting butterflies and moths for cabinet specimens, one needs a gauze net a foot and half deep, with the wire

frame a foot in diameter; a bottle containing a parcel of cyanide of potassium gummed on the side, in which to kill the moths, which should at once be pinned in a cork-lined collecting box carried in the coat pocket. The captures should be spread and dried on a grooved setting board, and a cabinet formed of cork-lined boxes or drawers; or as a substitute for cork, frames with paper tightly stretched over them may be used, or corn, or palm-pith. Caterpillars should be preserved in spirits, or glycerine with a little spirits, or strong salt and water, while some ingeniously empty the skins and inflate them over a flame so that they may be pinned by the side of the adult.

EXPLANATION OF PLATE 2.

Fig. 1. *Eustixis pupula* Hübner, female; 1*a*, larva, 1*b*, pupa. Feeds on *Sideronytum tenax.*

Fig. 2. *Cœlodasys biguttatus* Pack., male; 2*a*, larva; 3*a*, pupa. Feeds on *Ipomea coccinea.*

Fig. 3. *Dryopteris,* probably undescribed, female; 3*a*, larva; 3*b*, pupa. Feeds on *Viburnum nudum.*

Fig. 4. *Acontia metallica* Grote, male; 4*a*, larva; 4*b*, pupa. Feeds on *Hibiscus palustris.*

Fig. 5. *Homoptera edusa* (Drury). 5*a*, larva; 5*b*, pupa. The plant on which it feeds is not named.

Fig. 6. *Hyperetis,* species not known, female; 6*a*, larva; 6*b*, pupa. Feeds on a species of *Azalea.*

Fig. 7. *Boarmia,* species not known, female; 7*b*, larva; 7*a*, pupa. Feeds on *Helenium.*

Fig. 8. *Acidalia,* species unknown. 8*a*, larva; 8*b*, pupa. Feeds on *Trillium.*

Fig. 9. *Herminia,* species not identified, male; 9*a*, larva; 9*b*, pupa. Feeds on *Rhexia mariana.*

Fig. 10. *Helia æmulalis* (Hübner)? female; 10*a*, larva; 10*b*, pupa. Feeds on *Phlox speciosa.*

Fig. 11. An unknown species of *Phalænidæ,* male; 11*a*, larva; 11*b*, pupa. Feeds on *Coreopsis.*

Fig. 12. A species of *Botys,* male; 12*a*, larva; 12*b*, pupa. Feeds on *Ipomea.*

Fig. 13. A species of *Botys,* female; 13*a*, larva; 13*b*, pupa. Feeds on a species of *Crotalaria.*

REVIEWS.

Modern Ideas of Derivation.* — This felicitous title heads an equally expressive and concise summary of the various theories on the origin of species, treated by the strong hand of an accomplished and veteran observer.

Professor Dawson recognizes that Darwin has given form and coherency to researches upon the origin of species, but omits one very important consideration, to which we think the greatest effect of his book is due. The novel and exact methods of investigation, the analytical character of the book powerfully influenced a much larger class of minds than those who heartily accepted the theory of a struggle for existence. The doctrine of natural selection may or may not be true, but the mode of study which it inaugurated began a new era in the history of natural sciences and is already producing results of great value.

The author begins his review with Professor Owen, but succeeds no better than his predecessors in the same field, and is forced finally to deduce his opinions from the oracular manner in which that distinguished anatomist writes of certain animals as being "made," "formed," or "brought forth." Professor Huxley gets a well deserved and very sarcastic notice for his late attempt to prove the theory of derivation by "a series of cleverly arranged transitions," between some of the larger fossil reptiles (Iguanodons) and the ostriches. "Yet," writes Professor Dawson, "he could not have placed together any two members of the supposed series without convincing any naturalist that an enormous gap had to be filled between them." The views of Darwin are summed up as follows: "That all organized beings are engaged in a struggle for existence; that in this struggle certain varieties arise, which, being better suited to the conditions, prosper and multiply more than others: that this amounts to a 'Natural Selection,' similar in kind to the artificial selection of breeders of stock; that members of the same species isolated from each other and subjected to struggles of different kinds, will in process of time become specifically distinct."

Professor Dawson objects to this theory for several reasons. The most important are that "conditions which involve a struggle for existence are found by experience to result in deterioration and final extinction rather than improvement, and are directly opposed to those employed by breeders for their purposes," and that the possibilities of geological history are exceeded by the enormous time demanded by Darwin for accomplishing the developmental change from one species to another.

Seemingly no worse or more contradictory comparison could be made

*Modern Ideas of Derivation. By Principal J. W. Dawson, LL. D. Canadian Naturalist, Vol. iv, No. 2. June, 1869.

than that between the laws which govern the transmission of characteristics among races perpetually clashing in the "struggle for existence," and those influencing the production of different breeds among animals enjoying the protection of the animal breeder. We, however, think that Professor Dawson would find it difficult to establish the truth of this very important proposition, that the conditions involving a struggle for existence necessarily lead to extinction. Darwin himself has shown that it leads to the extinction of those races which are not possessed of certain advantages, and that it cannot according to physiological laws do otherwise than develop in a higher degree those points or changes in the favored races which enabled them to gain their first victories over their weaker brothers.

The last objection, with regard to the lapse of time demanded for specific changes according to the Darwinian theory, is becoming stronger every day. Deep sea dredgings have shown us that computations of geological time, based upon the thickness of rocks, and the presence of different assemblages of animals or faunæ in successive beds are not to be relied upon. These explorations have detected the presence of very distinct faunæ dependent upon changes of temperature, and very different rocks in the course of formation within comparatively narrow limits. Thus it no longer becomes necessary to account for the change from one fossil fauna to another, as we pass from one stratum or bed to another in geological time, by imagining the lapse of ages and a corresponding modification of the organization of the animals included in the lowest bed. A simple change of fourteen degrees Fahrenheit may possibly make the difference between a limestone composed entirely of organic remains, and a sandstone containing the fossil remnants of a totally distinct fauna, though both of these may have been composed of contemporaneous animals.*

The author's remarks upon Professor Cope's late paper before the American Association so well expresses the substance of the new theory of derivation that we quote them in full:

"The last of these hypotheses which I shall notice, and, in my view, the most promising of them all, is one which has recently been ably advocated by Mr. Edward D. Cope in a memoir on the 'Origin of Genera,' published in the Proceedings of the Academy of Natural Sciences,† and which is based on the well known analogy between embryonic changes, rank in the zoological scale and geological succession. It may be illustrated by the remarkable and somewhat startling fact, that while no authenticated case exists of animals changing from one species to another, they are known to change from one genus or family to another, and this without losing their individuality. Professor Dumeril, of Paris, and Professor Marsh, of New Haven, have recently directed attention to the fact that species of *Siredon*, reptiles of the lakes of the Rocky Mountains of Mexico, and which, like our North American *Menobranchus*, retain their gills during life, when kept in captivity in a warmer temperature than that which is natural to them, lose their gills, and pass into a form hitherto regarded as of a different genus and family,—the genus *Amblystoma*. In this case we may either suppose that the Amblystoma, under unfavorable circumstances, has its maturity and reproduction prematurely induced be-

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* See Recent Explorations of Deep Sea Fauna, by A. E. Verrill. American Journal of Science and Art, 2d series, January, 1870.

† Philadelphia, 1869.

fore it has lost its gills, or that the Siredon has, under certain circumstances the capacity to have its period of reproduction arrested until it has gone on a stage farther in growth and has lost its gills. In any case the same species — nay, the same individual — is capable of existing in a state of maturity as a creature half fish and half reptile in regard to its circulation, or in a more perfect reptilian state in which it breathes solely by lungs. Farther, we may suppose conditions of the earth's surface in which there would only be Siredons or only Amblystomas, and a change in these conditions inducing the opposite state. Here we have for the first time actual facts on which to base a theory of development. These facts point to the operation of two causes — first, the possible *Retardation* or *Acceleration* of development, and secondly, the action of outward circumstances on the organism capable of this retardation or acceleration. We here substitute for the tendency to vary of Owen's theory, the ascertained fact of reproductive retardation or acceleration, and for the struggle for existence, the action of changed physical conditions, and for the question as to the change of one species into another, the change of the same species from one genus into another. Farther, instead of vague speculations as to possible changes of allied animals, we are led to careful consideration of the embryonic changes of the individual animal, and as to the differences that would obtain were its development accelerated or retarded. We can thus range animals in genetic series within which anatomical characters would show change to be possible. I cannot follow these series out into the elaborate lists tabulated by Mr. Cope, but may proceed to notice the limitations which his views put to the doctrine of derivation. It is obvious that, if this be the real nature of derivation as a possible hypothesis, then derivation must follow the same law with metamorphism and embryonic development.

According to this view, also, a species once created may have in itself a capacity for passing through several generic forms, constituting a cycle which ever tends to return into itself, or to advance and recede by steps more or less abrupt under the law of retardation and acceleration, combined with the influence of external circumstances. Yet the dimensions of the orbit of each species must be limited, its duration in time must also be limited, and its capacity to pass into a really new species must still be a point subject to doubt, but open to anatomical investigation and inference. As already hinted, it is a most important point of this theory, that when we have ascertained the series of embryonic changes of any animal, we have thereby ascertained its possibilities in regard to accelerated development. Its possibilities in regard to retarded development may be inferred by similar studies of animals higher in the scale. Now, if we knew the embryonic history of every animal, recent and fossil, in its anatomical details, we should be able to construct out of this a table of possible affiliation of animals, and should be able to trace our existing species through the same genera, families, orders and classes in which they might have existed in geological time, and to predict what they might become in time still to come."

This theory of acceleration we have also shown to be the law of growth * among the Nautiloids and Ammonoids. Thus the discoidal Nautili, though an ancient group, do not accomplish during their entire life, from the Silurian to the Tertiary, such extensive changes in the septa as the Clymeniæ do in the course of a single geological epoch, the Devonian. Each species of this group adds something to the serial complication of the lobes and cells of the sutures until from a species *Clymenia lævigata*, inseparable generically from the Nautiloids, there is produced a species, *Clymenia pseudogoniatites*, which is a true Ammonoid.

This last species presenting itself to the geologist suddenly according to the usual action of the law of acceleration, has young with lateral lobes, and an internal siphon like the other Clymeniæ, but both the young and adult have the abdominal lobes and superior lateral cells of an Ammonoid, as well as the more involute whorls of that order. This case is precisely parallel to that of the growth of the Siredon salamander into

* On the Parallelism between the Different Stages of Life in the Individual and those in the entire Group of the Molluscus Order, Tetrabranchiata. By A. Hyatt. Memoirs Boston Society of Natural History, Vol. 1, Part 2, 1867.

an Amblystoma, and presents itself to the geologist when compared to the lower Clymeniæ in the same way, the only difference being that in this case the characteristics of a different order of animals are produced by the acceleration of the growth, instead of a distinct family and genus merely.

Other instances are brought forward in the memoir referred to above which show the action of the law of acceleration, when applied to different species, and since then other observations have been made which demonstrate with equal clearness the agency of the law of acceleration in the production of varieties and even of individual differences.

Thus one of the best known species of the Lower Lias, *Asteroceras* (Ammonites) *obtusum*, is divisible into several varieties. For the sake, however, of reducing it as much as possible we will eliminate all of these but three, and consider only the English specimens from one locality, Lyme Regis. These have three distinct variations of form. The first has the ordinary rounded sides and abdomen, with very broad immature keel and exceedingly shallow channels, while the *pilæ* (costæ) are prominent and round off evenly at either end. The channels appear on the last quarter of the third, and almost immediately attain their ultimate adult depth and aspect on the fourth volution; the second has the same peculiarities in the larger number of individuals, but accelerates them by adding to the depth of the channels and the height of the keel after the fourth volution, producing thereby adults with deeper channels and more prominent keels. There are different degrees of this acceleration in different individuals, some having shallower channels than others.

The third variety attains the adult characteristics of the most advanced members of the second variety on the fourth whorl, and on the fifth, flattens the sides. The first and second varieties have gibbous or rounded sides, but the third is a transitional variety, approximating to *Asteroceras stellare*. The accelerations show themselves also in the development of the pilæ; the second variety ceasing to be smooth and beginning to form these lateral projections at an earlier age than the first, and the latter forms the same parts at an earlier age than in the first variety.

This whole progress in the form and characteristics of parts takes place by individual accelerations. Thus in the first variety we have certain individuals which remain smooth longer than others which nearly equal the rate of growth observable in the second variety, but are retained in the first by the slower development of the keel and channels. An objection may and probably will be made to this view, that the third is really a variety of *Asteroceras stellare*, and does not belong to *Asteroceras obtusum* at all. This alternative would be even more favorable to the theory here advanced than that given above. The difference is less in all respects between the third variety described above and the unquestionable *Asteroceras obtusum*, than between the former and *Asteroceras stellare*. Therefore any estimation of the value of their characteristics which would join the third variety to the latter species must also include the former

species as a variety under the same name. If at the other end of the series we should be permitted to add *Ammonites Turneri*, which we think will perhaps prove to be merely a local variety of *A. obtusum*, the evidence becomes additionally strong. This variety, or species, has only the faintest marks of channel grooves, even upon the first quarter of the sixth volution, both upon the shell and upon the cast, and in the typical *Turneri* the pilæ at this age run nearly to the base of the keel. The septal proportions and outlines of the lobes and cells are the same as in the typical *Asteroceras obtusum*, and in all respects it is similar to that species, differing only in the later or slower production of the channels and keel and in its somewhat smaller size.

A third opinion that all of these were distinct species, may be answered first, by reference to the accelerations in the development of the pilæ occurring between the different individuals of the first variety, which in that case become types of varieties, and, also, by citing other species. Thus one species of a lower genus *Arnioceras incipiens*, all the specimens of which are from one locality, fades by regular and inseparable gradations from specimens whose whorls possess no channels in the adult to those which have these parts better defined even at an early age than in the adult of the third variety described above. This position might also farther be strengthened by showing that this presence or absence of channels becomes in the Middle Lias of such importance that it constitutes a generic distinction in the family group (*Hildoceratidæ*) which is nearest allied to that which includes the species referred to above, the family of *Discoceratidæ* (*Arietes*). Thus *Hildoceras* (*Ammonites bifrons* and *Walcottii*) differs from *Grammoceras* (*Amm. striatulus*, *Amm. Aalense*, etc.) principally in these characteristics.*

The presence or absence of channels, therefore, or any change of form to which the abdomen may be subjected, cannot, to use the terms of the modern systematist, be considered as of slight importance even though we find them, when first introduced, subject to simple varietal changes in some species.

The limits of a review do not permit us to continue this part of the subject. Leaving many similar instances, therefore, to appear in due course of publication, we will pass on to the consideration of the application of the theory to another series of facts. We refer to the changes which take place during the old age of the individual and also of the group. They bear directly upon that portion of Professor Dawson's remarks which refer to the possibility of determining beforehand the future course of the changes of a group, but have been accidentally passed over in silence by him. He has also given Professor Cope the undivided credit of discovering the law of acceleration, whereas the memoir we have referred to above, which has escaped Professor Dawson's notice, will remove all doubt that the aim of a large part of the investigations there

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*Bulletin of the Museum of Comparative Zoology, No. 5, p. 99.

recorded is identical with those of Professor Cope's more elaborate essay. We have no desire for controversy and regard scientific claims as generally speaking not worth contending for, but feel that silence, in the present instance, would place in a false light the object of these investigations, and vitiate the original value of the results of much labor not yet published. The quotation below will serve to justify these remarks, and at the same time bring us back to the more agreeable and legitimate subject of this review.

"This law" (of acceleration) "applied to such groups as have been mentioned, produces a steady upward advance of the complication. The adult differences of the *individuals* or species being absorbed into the young of succeeding species; these last must necessarily add to them by growth, greater differences which in turn become embryonic, and so on; but when the same law acts upon some series whose individuals alter the shell in old age, precisely the reverse occurs, and a general decline takes place. The old age characteristics in due course of time or structure, become embryonic and finally affect the entire aspect of the higher members of the series."* In other words there are certain degradational characteristics first found in the old age of the shell, which are inherited at earlier periods by species standing higher in the series, just as the adult characteristics are inherited by them in the young. Thus the degradation and ultimate extinction of groups of animals may be accounted for by the law of acceleration quite as accurately as their rise and progress in organization.

These degradational tendencies bring about in the old age of the individual quite a close resemblance to its own young,† and in the group their inherited influence may be traced to its ultimate results in the peculiar unrolled shells of the Cretaceous Ammonites, which are, form for form, the same as those of the earlier Nautiloids in the older formations. In other respects also the aberrant Ammonoids of the Cretaceous may be shown to be degraded species; in their simpler septa when compared with the normal formed ammonites, having in the adult only the six lobes of the young, and in their ornamentation, and simple, rounded, keeless and channelless whorls.

Thus the retardation of development which is invoked to account for the tendency of species to return to forms analogous with those with which they began; or, in other words, to complete cycles either as a series or in geological time, becomes only another phase of the law of acceleration. The very complete analogy, to say the least, which exists between the life of a group and that of an individual member points very decidedly to some law that governs alike the growth and decline of the individual and the group to which it may belong. The struggle for existence may, and probably does as well as physical circumstances strongly influence the action of this law, but that it has no controlling influence is

* "On the Paralellism," etc., p. 232.

† First noticed by D'Orbigny. Pal. Francaise. Terr. Cretaces p. 381.

proved, we think, by the fact that degradational or senile tendencies are inherited.

In this connection I would suggest that the Turrillites and other allied spiral shells, will ultimately be found to be the legitimate descendants of the deformed Turrillites described by D'Orbigny from the Lower Lias beds. It is now generally acknowledged by European writers that these forms are discoidal ammonites that have departed from the usual mode of growth common to their species, and instead of revolving always in the same plane the whorl has become slightly assymetrical, and thus begun to form the assymmetrical spiral of the genus Turrillites. This tendency is quite common with the septa of *Psiloceras psilonotus* and other species, and in the shell, also, but is so faintly expressed that it is difficult to distinguish from the effects of compression. If this and other instances of a similar kind be finally substantiated we have here still another application of the law of acceleration to characteristics, which naturalists have been hitherto accustomed to call deformities.

According to the theory of natural selection only favored races can prolong their existence by perpetually inheriting the advantages of their ancestors, and certainly the degradational characteristics as displayed in all the terminal species of the ammonoids cannot be explained in this way. Here also we have the limitation of the cycle of changes or variations, of which a species or form may be supposed to be capable, at least partially accounted for; and as Professor Dawson and others have pointed out, the theory of natural selection makes no provision for such restrictions. Reversion cannot be called upon to explain the return of the Nautiloid forms in the Ammonoids of the Cretaceous, because they show the effect of traceable inherited characteristics continually augmenting in force, and because these are senile to the group, and are no more reversionary than the old age of the individual is a reversion to its own younger state. They are accomplished by methods opposed to the metamorphoses occasioned by the progress of the group in structure and by growth in the individual. They take place by a gradual suppression or atrophy of the adult characteristics in the individual, and in the group, by an unrolling of the closely coiled and deeply involute whorl of the Jurassic Ammonites, and they occupy the polar extreme of structure and life in both cases.

We would remark, in conclusion, that Professor Dawson does not wholly commit himself to the new theory, but regards it as "holding forth the most promising line of investigation" as yet advanced. Though the author of the theory in common with Professor Cope, we cannot refuse to endorse Professor Dawson's judgment as regards this decision also. The law certainly explains much which has been hitherto inexplicable, but until the extent to which it may be modified by physical causes, and perhaps natural selection, be fully understood, an unprejudiced mind cannot consider it as capable of clearing away all our present difficulties. It gives us, perhaps the means of asserting that the plasticity of organs

have certain limits; that variations can arise from natural selection, or physical changes, only when these act in given directions and for a given time, after the expiration of which, whether in the individual or the group, if sudden death do not intervene, all changes must be degradational in character. Physical causes, and the struggle for existence can no longer improve the vitiated organization when it has passed this period. Its death is decreed as certainly as its line of developmental changes must have been before it was born, and whatever agency other laws may have, they can only act with more or less force and velocity in these predetermined paths of progress and decline, or cut them short by the destruction of the organization.—A. Hyatt.

The Torrey Botanical Club, which, under the auspices of its President and Nestor, meets at the Herbarium in Columbia College, began with the year to issue its "Bulletin," in monthly numbers of four pages each. The notices and memoranda thus issued relate chiefly to the local flora of New York, which is the special charge of the Club; but matters of more than local interest are touched upon, making it well worth the attention of our botanists throughout the country. For example, in the February number, Mr. Leggett, the editor, explains the anomaly of *Lepidium Virginicum* having accumbent cotyledons, contrary to all the rest of the species, showing that what may be termed the petioles of the flat cotyledons, in line with the radicle, and in which the bend is made, are in the position answering to incumbent, and so the cotyledons take the accumbent position by a twist of ninety degrees. The "Bulletin" is furnished, upon application to the editor, 224 East Tenth street, New York, for a dollar a year, or seven copies for five dollars.

Fossil Plants from the West.*—This report closes Dr. Hayden's report reviewed by us in March, 1870. By some oversight we confused it with a former paper of Professor Newberry, and thus passed by some of the most important results of the explorations. The first portion is a general review of the geology of North America, and as these government reports, notwithstanding their wide distribution, generally have but few non-scientific readers, we shall republish this for the benefit of our subscribers in some succeeding number.

The chapter on the "Cretaceous Flora" gives a concise summary of the various government expeditions which have made collections of the plants of this period. The conclusions reached are identical with those which we have already quoted in the review referred to above in March, 1869, page 41.

Among the Miocene plants Dr. Newberry finds *Onoclea sensibilis*, a species undistinguishable either from the living forms of this species or those found in Europe, only on the island of Mull, off the west coast of Scotland. This and the large number of other identical miocene species, lead to the inference that North America and Europe were connected by

* Report on the Cretaceous and Tertiary Plants. By Professor J. S. Newberry.

an intermediate continent. "If this inference should be confirmed by future observations, we should then see how the eocene tropical or subtropical flora of Europe was crowded off the stage by the tropical flora of the miocene, which latter accompanying a depression of temperature, had migrated from America, while the eocene flora had retreated south and east, and is now represented by the living Indo-Australian flora, characterized by its *Hakeæ*, *Dryandreæ*, *Eucalypti*, etc., etc., which form so conspicuous an element in the eocene flora of Europe." Instances in which the miocene flora occurs on the McKenzie River, Disco Island, Iceland, and the Island of Mull are then brought forward to show that this land connection must have occurred to the northward, and that the country was then in possession of a milder climate than now reigns in the same latitude.

In discussing the causes which produced this difference of climate Professor Newberry gives his adherence to none in particular, but thinks that the deflection of the Gulf Stream would be the most natural method and at the same time places an objection in the path of the astronomical theorists, which they will find it difficult to combat. It will be remembered by our readers that many of the geologists of the day account for the former presence of a warm climate in the Arctic region, by supposing that the earth has, in former times, passed through a warmer region in space. This cannot be assumed to be the cause in the present instance; for any "cosmical cause, producing a general elevation of temperature on the earth's surface, would have given us a tropical flora on the Upper Missouri, whereas we find in the miocene flora there, as yet no tropical plants."

RELATIONS OF THE ROCKS IN THE VICINITY OF BOSTON.* — Professor Shaler regards all the syenites of this vicinity as of sedimentary origin, and rejects the old theory of their Plutonic origin. In this he is supported by the late discoveries of the Eozöon in this vicinity, and by the researches of Professor T. Sterry Hunt, published in the last number of the "American Journal of Arts and Sciences." The section of the rocks in the neighborhood of Quincy is described as consisting of a layer of quartzites "to the north of the Quincy Syenite Hills, a hidden section of about three hundred feet thickness, and the Braintree series of two hundred feet. Another section of the Chesnut Hill Reservoir is also described, composed of Cambridge slates for seven hundred feet, Roxbury conglomerate for ten feet, thirty feet more of slate and conglomerate again extending to the edge of the Charles River flats in Brighton, where they give place to a sandstone.

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* Abstract of Some Remarks on the Relations of the Rocks in the Vicinity of Boston. By N. S. Shaler. Proc. Boston Soc. Nat. Hist., vol. xiii. Dec. 3, 1869. Pamph., pp. 7.

NATURAL HISTORY MISCELLANY.

BOTANY.

ON THE FERTILIZATION OF GRASSES. — In gently flowing rivers of tropical America grow many fine aquatic grasses, species of Luziola, Oryza, Leersia, etc. The following note is from my journal under date of December, 1849, when threading in my canoe among the islands of the Trombetas: — "This channel was lined on both sides by a beautiful grass — a species of Luziola — growing in deep water, and standing out of it two or three feet. The large male flowers, of the most delicate pink, streaked with deep purple, and with six long yellow stamens hanging out of them, were disposed in a lax terminal panicle; while the slender green female flowers grew on the bristle-like branches of much smaller panicles springing from the inflated sheaths of the leaves that clothed the stem. As the Indians disturbed the grassy fringe with the movement of their paddles, the pollen fell from the antlers in showers," and would, doubtless, some of it, attain the female flowers disposed for its reception.

A parallel case to the above is that of the common Maize (*Zea Mays* L.), where the male flowers are borne in a long terminal raceme or panicle, and the female flowers are densely packed on spikes springing from the leaf-axils. Here the male flowers must plainly expand before the pollen contained in their anthers can be shed on the female organs below, whether of the same or of a different plant. That there are frequent cross-marriages in Maize is evidenced by the numerous varieties in cultivation in countries where it is a staple article of food, as in the Andes of Ecuador, where nine kinds, varying in the color of the grain (through white, yellow, and brown, to black), in its size, consistence, and flavor, are commonly cultivated; besides many others less generally known.

In *Pharus scaber* (H. B. K.) another tall broad-leaved grass, the spikelets stand by twos on the spike — a sessile female spikelet, and a stalked male spikelet.

In the fine forest grasses of the genus Olyra, whereof some species, such as *O. micrantha* (H. B. K.), rise to ten feet in height, and have lanceolate leaves above three inches broad, and a large terminal panicle, with capillary branches, like those of our *Aira cæspitosa*, it is the lower flowers that are male, with large innate (not versatile) anthers, and the upper that are female, with two large stigmas, that are either dichotomously divided, or clad with branched hairs, thus exposing a wider surface to the access of the pollen. And as the panicle is often pendulous, many of the male flowers, although placed lower down the axis, are actually suspended over the terminal female flowers.

It is generally to be remarked of declinous grasses, that either the male

flowers are very numerous, as in *Zea Mays*, or the stamens are multiplied in each male flower, as in Pariana, Leersia, Guadua, etc.; or the stigmatic apparatus of the female flowers is enlarged, so as almost to insure impregnation, as in Olyra and Tripsacum.

In the Bambuseæ I have gathered, belonging to the genera Guadua, Merostachys, and Chusquea, the flowers are more or less polygamous, and the stamens of the male flowers often doubled. But there is scarcely a genus in the whole order which is not described as having some flowers by abortion, neuter or male, and especially those that have biflorous spikelets, such as the Paniceæ. Some grasses, of normally hermaphrodite genera, are not unfrequently truly unisexual, such as certain species of Andropogon. I have occasionally seen panicles of *Orthocladus rariflorus* (Nees), a grass peculiar to the Amazon, quite destitute of stamens, and therefore purely female.

To come home to our own country: Is all the pollen wasted that a touch or a breath sets free from the flowers of grasses in such abundance? Watch a field of wheat in bloom, the heads swayed by the wind, lovingly kissing each other, and doubtless stealing and giving pollen. Consider, too, that throughout Nature, heat or moisture, or both, are essential to the emanation of the impregnating influence. In all our Festuceæ, as well as in Cynodon, Leersia, and some other genera, the stigmas are protruded from the side or from the base of the flower at an early stage, often before the stamens of the same flower are mature — thus as it were inviting cross fertilization from the more precocious stamens of other plants which are already shedding their pollen.

All who have gathered grasses will have remarked that some have yellow anthers, others pink or violet anthers; and that anthers of both types of color may co-exist on distinct individuals of the same species. The same peculiarity is just as noticeable in tropical grasses, and (without professing to give a complete physiological explanation of it) this is what I have observed respecting it. The walls of the anther-cells are usually of some shade of purple, but are so very thin and pellucid, that when distended with mature pollen the yellow color of the latter is alone visible. When the pollen is discharged, the anthers resume their original purple color, shortly, however, to take on the pallor or dinginess of decay. Where the anthers emerge of a purple hue, and change from that to brown, it will probably be found that they have discharged their pollen while still included in the flower. These observations, made without any reference to the question now in hand, require to be renewed and tested: and in them, as in all that precedes, I am open to correction.

Of grasses with bisexual flowers, there are two ways in which the ovary may be fertilized, namely, either by the pollen of its own flower (closed or open), or by that of other flowers, after the manner of the declinous species. In the latter case, the pollen may be transported by the wind, or in the fur of animals (as I have observed the seeds of Selagin-

ellas in South America), or in the plumage of birds. The agency of insects has not been traced in the fertilization of grasses, but may exist. The little flies I have seen on the flowers of grasses seemed bent on depositing their eggs in the nascent ovaries, but may also have aided in cross-fertilization. In the Amazon Valley grasses are often invested by ants, who, indeed, leave nothing organic unvisited throughout that vast region; and they also, I think, cannot help occasionally transferring grains of pollen from one flower to another.

The flowers of Palms and Grasses agree in being usually small and obscurely colored, but contrast greatly in the former being in many cases exquisitely and strongly scented, whereas in the latter they are usually quite scentless. The odor of Palm-flowers often resembles that of Mignonette; but I think a whole acre of that "darling" weed would not emit more perfume than a single plant of the Fan Palm of the Rio Negro (*Mauritia Carará* Wallace). In approaching one of these plants through the thick forest, the sense of hearing would perhaps give the first notice of its proximity, from the merry hum of winged insects which its scented flowers had drawn together, to feast on the honey, and to transport the pollen of the male to the female plants; for it is chiefly diœcious species of Palms that have such sweet flowers. The absence of odoriferous flowers from the grasses seems to show that insect-aid is not needed for effecting their fecundation, but does not render its accidental concurrence a whit less unlikely.

That grasses, notwithstanding their almost mathematical characters, vary much as other plants do, is plain from the multitude of osculating forms (in such genera as Eragrostis, Panicum, and Paspalum), which puzzle the botanist to decide when to combine and when to separate, in order to obtain what are called "good species." Hence the conclusion is unavoidable that in grasses, as in other plants, variations of surrounding conditions induce corresponding modifications of structure, and that amongst the former must be enumerated cross marriages, however brought about. If the flowers of grasses be sometimes fertilized in the bud, it is probably exceptional, like the similar cases recorded of Orchids and many other families.

To conclude: the more I ponder over existing evidence, the more I feel convinced that in its perfect state every being has the sexes practically separated, and that natural selection is ever tending to make this separation more complete and permanent; so that the hypothesis of Plato, that the prototype even of man was hermaphrodite, may one day be proved to be a fact! — Dr. R. Spruce, *Scientific Opinion.* [See his paper in Journ. Linn. Society.]

Fungi on Insects. — Dr. Bail of Danzig, in a recent pamphlet, calls attention to the various kinds of fungus that are parasitic upon the larvæ of different insects, and his investigations are of some practical importance in relation to a possible check to the destruction of forest-trees, which goes on to an enormous extent in North Germany, through the

ravages of caterpillars. In certain seasons these caterpillars appeared to be attacked by an epidemic, their bodies being swollen to bursting, and white threads being visible between the rings of the body, which seemed to issue from the body itself. In this condition great numbers were found still clinging to the leaves. The destroying agent had been identified by Dr. Reichhardt of Vienna as the mycelium of a fungus which he named *Empusa aulicæ*. The distribution of the *Empusa* is very considerable; the only order of insects which is not at present known to be subject to their attacks being the *Neuroptera* (dragon flies, etc.); they are known to be parasitic upon *Coleoptera* (beetles), *Hymenoptera* (bees, ants, etc.), *Lepidoptera* (butterflies and moths), *Diptera* (flies and gnats), *Orthoptera* (crickets, etc.), and aphides, either in the larva or perfect condition, on water-insects, and even the same species on amphibia and fishes. Not only is their distribution over so many different animals remarkable, but also the prodigious rapidity of their development in the individual. The common house-fly is, in some years, destroyed by this parasite in vast numbers, and the dung-fly has been in certain districts almost annihilated. In the forests of Pomerania and Posen the caterpillars have been killed by it in such quantities that it may be considered to have saved the trees from total destruction. The fungi which Dr. Bail found to be the most destructive to insect life were those described by authors as *Cordyceps militaris*, *Isaria farinosa*, and *Penicillium glaucum;* the two latter forms he inclines to unite as different stages of growth of the same plant. — *The Academy.*

Insect-fertilization of Flowers. — In an article contributed to "Scientific Opinion" by Professor Delpino, he passes from orchids, which since Darwin's work upon them have attracted much attention in this respect, to the related families, one of which is familiarly represented in our gardens by the *Canna*, or Indian Shot. Here the arrangements depends upon the viscidity of the pollen, and the bursting loose of the style; the pollen is first deposited on an expansion of the style, whence it is taken away by the insect, to be deposited upon the stigma of the flower next visited.

Collected Notes on American Oaks. — *Concluded.* A. De Candolle, in "Prodromus" XVI, 2, 1864, describes two hundred and eighty-one species. Of these one hundred and twenty-two are American; of which twenty-nine are doubtful. He admits *Q. olivæformis* Michx., *bicolor* Willd., *grisea* Lbm., *pungens* Lbm., *hastata* Lbm., *Leana* Nutt., as species. Thirteen species from Endlicher's list are made varieties of others; sixteen are synonyms of others. De Candolle proposes three new species: *Q. Lindeni* (collected in New Grenada in 1842, by Linden), *Wislizeni* (1846, in New Mexico by Wislizenus), and *omissa* (from Seemann's collection, but omitted in "Plantæ Hartwegianæ"). *Q. dumosa* Nutt., and *acutidens* Torr., are not mentioned. Counting these omitted species, and dropping *olivæformis* and *Leana* as such; then uniting *grisea* with *oblongifolia*

and *pungens*, and placing *hastata* in *Emoryi*, we have ninety American species. But even this number may be in the future greatly reduced, particularly in the Mexican species, which are founded on a limited number of specimens, and with the habitat for the most part not stated.

Michaux attempted the first methodical disposition of the genus, as above mentioned, which was after him maintained by Pursh, Nuttall and Elliott. In Europe the important character taken from the ripening of the fruit was entirely neglected. Only Koch, in "Flora Germanica," 1837, gives notice that *Q. Cerris* ripened its fruit in the second year.

Then Spach, in Vol. XI. of his "Histoire Naturelle des Veg. Phanerog." 1842, applied this character to his natural arrangement of the oaks, which is founded on the form and duration of the leaves, the cup and the ripening. His disposition is this:

I. Deciduous leaves: Esculus.

1. Robur: Leaves sinuose, pinnatifid; lobes not bristle-pointed. Maturation annual; scales of the cup small, oval, appressed.
2. Cerroides: Leaves pinnatifid, lobes not bristle-pointed. Maturation annual. Scales of the cup, the lower imbricated and appressed; the upper ones subulate, loose and much longer.
3. Erythrobalanus: Leaves entire, mucronate or trilobed, or pinnate-lobed, bristle-pointed. Maturation biennial. Scales of the cup small, appressed, imbricated, not subulate.
4. Cerris: Leaves late deciduous or subpersistent, coriaceous; lobes or teeth bristle-pointed. Female flowers often from buds without leaves, and so the fruit lateral on the year's shoot. Maturation annual. Scales of the cup echinate.
5. Gallifera: Leaves late deciduous, becoming yellowish and brownish; lobes or teeth bristle-pointed. Maturation biennial. Scales of the cup short, appressed.

II. Leaves persistent: Ilex.

6. Suber: Maturation annual.
7. Coccifera: Maturation biennial.

Endlicher maintained the same disposition and characters, only changing *Cerroides* into Elæobalanus, and while Spach considers only the European, Western-Asiatic, and American species, he introduces the Eastern Asiatic, which he puts into the subgenus Cyclobalanus except one, *Quercus cuspidata*, which forms his subgenus Chlamydobalanus; the former are all in his subgenus Lepidobalanus.

Gay, in "Ann. des Sc. Nat., IV, 6," pointed out the errors in the above disposition. The character of maturation is mistaken in three groups: *Cerris*, *Gallifera* and *Suber*. *Q. Cerris* ripens its fruit the second year: so also *Q. ægilops* L., *castaneæfolia* C. A. Mey, and *persica* Jaub. & Spach. So the whole group Cerris has the maturation biennial. *Pseudosuber* Desf., and *hispanica* Lam., which Endlicher put as one species under Gal-

lifera, belong to Cerris. Spach forms, for the single species, *Q. infectoria* Oliv. To the group *gallifera*, with biennial maturation, Endlicher added *Q. humilis* Lam., *alpestris* Bois., and *hispanica* Lam., but the two former, as well as *infectoria*, ripen the fruit the first year. These groups contain only European species; the American botanist is more interested in Spach's group, *Suber*, with the species *Q. virens* Ait. This species was taken by all the authors from Michaux, the elder, to A. Gray, as maturing the fruit in the second year. Spach puts it with Suber, with annual maturation. In the "Prodromus," and in the latest edition of "Gray's Manual," it is annual. Gay agrees with, but does injustice to, Endlicher, when he says that Endlicher's seventy-seven American and thirty-five east Asiatic species, which never have been examined upon their maturation, had been joined with Suber. Endlicher ranges neither *virens* nor the rest in the group Suber, but into no group at all. His arrangement is thus: Ilex — 1. Mediterraneæ et orientales; VI. Suber. VII. Coccifera. 2. Americanæ. 3. Japonicæ, etc.

The disagreement of view in respect to maturation is explained by the fact that until now two different species, with different maturation, have been taken for one. Gay describes a species which grows in France and Spain along the Atlantic, and furnishes all the cork used in these countries. It is *Quercus occidentalis* Gay, with biennial maturation, and was kept before the discovery of Gay for Suber. It is remarkable that often quite similar species differ only in maturation, and it is not impossible that the mistake concerning *Q. virens* grounds on an interchange of *Q. cinerea* and the former. In regard to the first groups Gay follows Endlicher and Spach; but I think there is an objection to the second group Elæobalanus. The subulate prolongation of the upper scales of the cup is so variable that this character is not profitable to be used. in a natural arrangement. I have seen fruits of *Q. macrocarpa*, in which the prolongation of the scales was scarcely perceptible; on the other hand I have seen fruits of *Q. bicolor* or *Prinus discolor*, with very much prolonged scales. It is my opinion that *Q. macrocarpa* falls under the group Robur, and that the group Elæobalanus should be dropped.

There are two essays of A. De Candolle in "Ann. des Sc. Nat. ser., IV, Vol. XVIII." (1862): *Sur le fruit du chêne* and *Etude sur l'espèce.* De Candolle considers the proposed characters as incompetent to form natural groups in the section Lepidobalanus; for species closely related by one character are often disjoined by the other, but they are good enough to form artificial subdivisions, which are necessary from the great number of species. A new diagnostic character, discovered by De Candolle, is for the same reason unfit to form natural groups. This is the position of the abortive ovules at the base, or at the apex, of the ripe seed. Working out the genus *Quercus* for the "Prodromus" De Candolle mustered the different characters, to find out the best for determining the species. He considers as good ones, the size, form and pubescence of the stipules; the nervation of the leaf, respecting the direction and relative size of the

nerves of different degrees; their number to a certain point (?), the pubescence of the leaves and twigs (isolate or aggregate, on nerves or parenchyma); its length in younger parts; the duration of the leaves; the anthers (smooth or pubescent); the form of the cups in the upper part in the ripe fruit; the size of the cups, the general form and size of their scales; the maturation and the position of the abortive ovules.

Such characters as the following which, comprising many specimens, more or less differ on the same twig, are only good to determine varieties, viz.: the length of the petioles, the form of the leaf in regard to its diameter, to the base (acute, obtuse, or cordate); the depth of the incisures; the pointed or obtuse termination of the leaf; the presence and form of the bracts of the aments; the number of lobes of the perigone in the male flowers; the number of stamens; presence or absence of a mucro at the apex of the anthers; the length of the peduncle of the female flower; the swelling of the scales of the cup; the relative length of the acorn; the caducous or persistent pubescence of the underside of the leaves; the length and direction of bristles; the male flowers, whether pedicelled or sessile; the form of the cup at the base; the termination of the lower scales of the cup; the direction of the scales in the ripe fruit.

De Candolle adopts the three subgenera of Endlicher, adding two more from species which Endlicher puts under Lepidobalanus. The subgenus Androgyne, is formed by the single (Californian) species, *Quercus densiflora* Hook, which has the flowers of both sexes in an upright spike, male above, female below, the male flowers in bundles with three bracts, stamens double the number of the lobes of the perigone, the abortive ovules at the apex of the seed. The other new subgenus is Pasana, with South Asiatic species. All the other American species belong to the subgenus Lepidobalanus. The arrangement in the "Prodromus" is thus:

I. Lepidobalanus.

§ 1. Abortive ovules below. Maturation annual.

*** Leaves deciduous.**

Q. lyrata Walt., Q. macrocarpa Michx. (with var. abbreviata and minor); Q. olivæformis Michx., *Q.* bicolor Willd. (*Q. Prinus tomentosa* Michx., *Prinus discolor* Michx. f., *Michauxii* Nutt.). There is a variety cultivated in France, β. *platanoides*=*Q. prinus platanoides* Lam.=*Q. velutina* herb l'Her.=*Q. pannosa* Bosc. (which is, perhaps. *Q. mollis* Nutt.=*Q. filiformis* Muhl.). Q. Prinus L.=*Q. prinus palustris* Michx. (De Candolle refers to this the figure *Q. montana* in Emerson's Trees of Mass., Pl. 6. and the text to the next). *Q. Prinus* β *acuminata*=*Q. castanea* Muhl. (Emerson says the younger Michaux makes this a distinct species. This is not so as far as I know). *Q. Prinus* γ *monticola*=*Q. Prinus foliis obovatis* Wangenh.=*Q. montana* Willd., *Q. Prinus* δ *chincapin*=*Q. prinoides* Willd. =*Q. Prinus pumila* Mich.=*Q. chincapin* Ph.=*Q. Prinus chincapin* Michx. fil. *Q.* stellata Wg.=*Q. obtusiloba* Michx.=*Q. villosa* Walt.? There are three varieties β *Floridana*=*Q. Floridana* Shutlew, γ *depressa* (Nutt.) on

the upper Missouri, δ *Utahensis* the only oak between Salt Lake and Sierra Nevada, Q. ALBA L. with two varieties (?) β *repranda*, γ *microcarpa*.

Q. UNDULATA Torr.=*Fendleri* Lbm. Two varieties β *obtusifolia*, γ *pedunculata*. Q. DOUGLASII Hook, with three varieties, β *Gambellii*=*Q. Gambellii* Nutt., γ *novo-Mexicana*=*Q. Gambellii* Lbm. δ *Neaei*, *Q. Neaei* Lbm.=*Q. Douglasii* Bth. Q. LOBATA Née=*Q. Hindsii* Benth.=*Q. longiglanda* Torr. Q. GARRYANA Hook. Q. DRUMMONDII Lbm. These five species are very likely varieties of one species nearly related to the European Q. Robur.

The following are Mexican and Central American species, with dentate or entire leaves; the maturation of the fruit is not sufficiently known.

Q. CORRUGATA Hook, Q. INSIGNIS Mart. Gal., Q. STROMPOCARPA Lbm., Q. GALEOTTII Mart., Q. CIRCINATA Née, Q. MAGNOLIÆFOLIA Née, with two varieties, β *lutea*=*Q. flava* Née, γ *macrophylla*=*Q. macrophylla* Née=*Q. resinosa* Lbm., Q. OBTUSATA HB.=*Q. affinis* Mart. Gal.; the varieties β *pandurata*=*Q. pandurata* HB. γ *Hartwegii*=*Q. ambigua* HB.=*Q. Hartwegi* Benth.=*Q. nudinervis* Lbm., Q. POLYMORPHA Cham et Schl.=*Q. petiolaris* Benth.=*Q. varians* Mart. Gall.=*tuberculata* Lbm., Q. OMISSA A. DC., Q. LAXA Lbm.=*Q. callosa* Mart., Q. LAETA Lbm.=*Q. obtusata* var. Bth., Q. BENTHAMI A. DC.=*undulata* Bth., Q. TAPUXAHUENSIS A. DC.= *Q. salicifolia* Bth., Q. CORTESII Lbm., Q. SARTORII Lbm., Q. SALICIFOLIA Née, Q. SEEMANNI Lbm., Q. GHIESBREGHTI Mart. Gal., Q. BARBINERVIS Benth., Q. GLAUCOIDES Mart., Gal.=*Q. elliptica* Lbm.

* * Leaves persistent.

Q. HUMBOLDTII Bonpl., Q. CITRIFOLIA Lbm., Q. COSTARICENSIS Lbm., Q. LINDENI A. DC., Q. TOLIMENSIS HB., Q. TOMENTOSA Willd.=*Q. pedunculata* Née=*Q. callosa* Bth. There are four varieties:—α. *communis*=*Q. tomentosa* Bth., β *bullata*, γ *diversifolia*=*Q. diversifolia* Née, δ. *abbreviata*, Q. RETICULATA HB.=*Q. spicata* HB=*decipiens* Mart. Gal., the variety β *Greggii*, Q. PULCHELLA HB., Q. GLABRESCENS Bth. with the var. β. *integrifolia*, Q. GRISEA Lbm. (probably *Q. oblongifolia* Torr.) Q. REPANDA HB., Q. MICROPHYLLA Née=*Q. repanda* Bth. with the var. β *crispata*, Q. OBLONGIFOLIA Torr., Q. PUNGENS Lbm., and HASTATA Lbm. (both being *Q. Emoryi* Torr.) Q. BERBERIDIFOLIA Lbm., Q. AGRIFOLIA Née=*Q. oxyadenia* Torr. I examined a number of acorns of this species and found in all of them the abortive ovules at the apex of the seed!, Q. CHRYSOLEPIS Lbm.=*Q. crassipocula* Torr.=*Q. fulvescens* Kell., Q. VIRENS Ait.=*Q. sempervirens* Cat.=*Q. Phellos* β. L.=*Q. Virginiana* Mill.=*Q. oleoides* Cham. and Schl.=*Q. retusa* Lbm., Q. LUTESCENS Mart. Gal.

§ 2. Abortive ovules below. Maturation biennial.

Leaves persistent.

Q. CRASSIFOLIA HB.=*Q. rugosa* Née=*Q. spinulosa* Mart. Gal., Q. SPLENDENS Née, with the var. β. *pallidior*=*Q. crassifolia* Bth., Q. SCYTOPHYLLA Lbm., Q. SIDEROXYLA HB., Q. LAURINA HB.

§ 3. Abortive ovules above. Maturation biennial.

* Leaves deciduous.

Q. FALCATA Michx.=*Q. elongata* Willd.=*Q. discolor* Ait.; there are two varieties, β *Ludoviciana*, γ *triloba*=*Q. triloba* Michx.=*Q. cuneata* Wg., Q. ILICIFOLIA Wg.=*Q. Banisteri* Michx., Q. CATESBÆI Michx., *Q. rubra* L. with the var. β *runcinata*, Q. PALUSTRIS Du Roi=*Q. rubra ramosissima* Marsh.=*Q. rubra dissecta* Lam., Q. GEORGIANA A. Curt., Q. COCCINEA *Q. coccinea* Wg.=*Q. rubra* α L. There are four varieties: α *coccinea*=*Q. coccinea* Michx.=*Q. ambigua* and *borealis* Michx. fils.; β *nigrescens*=*Q. tinctoria sinuosa* Michx.=*Q. discolor* Willd.=*Q. tinctoria* Michx. fils.; γ *tinctoria*=*Q. tinctoria* Batr.=*Q. tinctoria angulosa* Michx.=*Q. velutina* Lam., δ *Rugelli*, Q. SONOMENSIS Bth.=*Q. rubra* Bth. in Pl. Hartw., Q. LEANA Nutt. De Candolle considers the hybridity of this as not certain. It is perhaps not so scarce as supposed; there is besides the known individuals one in Fulton County, Illinois, and one near Peoria, the latter in the immediate neighborhood of *Q. coccinea* and *imbricaria*. Q. TOTUTLENSIS A. DC., Q. PHELLOS L. with the var. β *subimbricaria* (hybrid?), Q. IMBRICARIA Michx. with a var. β *spinulosa*, Q. NIGRA L.=*ferruginea* Michx. fils.=*Q. Marilandica* Cat.; there are two varieties, β *quinqueloba*, γ *tridentata*, Q. SKINNERI Bth., Q. XALAPENSIS HB., Q. WARSCEWICZII Lbm.=*Q. glabrescens* Seem.=*Q. oöcarpa* Lbm., Q. CALOPHYLLA Cham. and Schl.=*C. Alamo* Bth.=*Q. intermedia* Mart. Gal.=*Q. acuminata* Mart. Gal.

* * Leaves persistent

Q. GRANDIS Lbm., Q. ACUTIFOLIA Née=*Q. furfuracea*, there are five vars.: β Bonplandi, γ *angustifolia*=*Q. acutifolia* Thib., δ *conspersa* Bth.=*nitida* Mart. Gal. ε. *longifolia*=*longifolia* Lbm. ζ *microcarpa*, Q. WISLIZENI A. DC., Q. AQUATICA Walt., Willd.=*Q. nigra* L. α=*Q. uliginosa* Wg.=*Q. Phellos maritima* Michx.=*Q. maritima* Willd., of this five varieties are enumerated; β *laurifolia*=*Q. laurifolia* Mich.=*Q. hemisphærica* Bartr. γ *heterophylla*=*Q. heterophylla* Michx. fils. (hybrid?), δ *stipitata*, ε. *dentata*=*Q. dentata* Bartr.=*Q. nana* Willd? ζ *myrtifolia*=*Q. myrtifolia* Willd. Q. NITENS Mart. Gal.=*Q. commutata* Lbm., four vars.; β *podocarpa* γ *ocoteæfolia*=*Q. ocoteæfolia* Lbm., δ *major*, ε *subintegra*=*Q. laurifolia* Bth., Q. LANCEOLATA HB. with the var. β *undulato-dentata*=*Q. laurina* Lbm., Q. DEPRESSA HB., Q. GRANULATA Lbm., Q. LINGUÆFOLIA Lbm., Q. ELLIPTICA Née with var. β *microcarpa*=*Q. perseæfolia* Lbm.=*Q. microcarpa* Lbm., Q. NECTANDRÆFOLIA Lbm., Q. LEIOPHYLLA A. DC.=*Q. lancifolia* Lbm., Q. CASTANEA Née=*Q. mucronata* Willd.=*Q. tristis* Lbm. the four vars.: β *sublobata*, γ *tridens*=*Q. tridens* HB., δ *glabrata*=*Q. Mexicana* var *glabrata* Seem., ε *Mexicana*=*Mexicana* HB., Q. LANIGERA Mart. Gal., Q. CRASSIPES HB.=*Q. Mexicana* Bth., Q. CINEREA Michx.=*Q. Prinus* β L=*Q. Phellos cinerea* Spach, with four vars.: β *dentato-lobata*, γ *humilis*=*Q. humilis* Walt., δ *pumila*=*Q. pumila* Walt.=*Q. sericea* Willd.=*Q. Phellos pumila* Michx., ε *nana*, Q. RUGULOSA Mart. Gal., Q. CONFERTIFOLIA HB.

Then follow twenty-nine doubtful species.

II. ANDROGYNE.

Q. DENSIFLORA Hook. and Arn.=Q. *echinacea* Torr., the var. β *Hartwegi* is *Q. densiflora* Bth. in Pl. Hartw.

De Candolle supposes that of the species now known and described about two-thirds are provisional, and that when all the species of America and Asia now adopted are as well studied as the European, the "good species" will be reduced to about one hundred; then the American species would scarcely be more than fifty. This is credible when we perceive that the single species *Q. Robur* as proposed by De Candolle includes thirty-two varieties, and nearly a hundred synonyms. He went to work without prejudice or prepossession; he examined specimens by hundreds from different localities; and the result was that he had to drop many supposed "good species." What will become of our American, particularly the Mexican species, when once worked out in that way?

I thought I had a very good character, neglected by all authors, in the bud. The *Quercus coccinea*, wherever I found it here (Peoria) had a conical pointed tomentose five-ridged bud, with five rows of scales, and I was sure I should never see it otherwise. Now I get from northern Illinois a number of specimens with the acorns and all the other characters decidedly those of *Q. coccinea*, but some of them with smooth round buds, just as in *Quercus rubra*. We have now about half a dozen species united in *Q. coccinea;* the difference between *Q. rubra* and *Q. palustris* is so insignificant that the latter could be taken as a variety of the former, and perhaps, when we compare all the black and red oaks by many hundreds of specimens from all the different sections of the country, the limits between the species as now accepted would be very uncertain. Even *Quercus bicolor* seems to me to be a transitional form between *Q. macrocarpa* and *Q. Prinus;* to the former it is approximate by the often subulate scales, the pubescence of the lower side of the leaves, the buds, and the scaly bark of the twigs, which are often corky in *Q. macrocarpa.* An exact definition of the term "species" has never been proposed. Since Darwin's theory has made the stability of species questionable, it has lost much of its importance; but we want a certain term, be it species, or form, or race, or whatever it be: we want a name for an object, that it may be understood. That is the task of species. I cannot see more in it.—FRED. BRENDEL, *Peoria, Ill.*

DOES AIR DUST CONTAIN THE GERMS OF DISEASE?—Dr. Tyndall, in a recent lecture, asserted: (1), that the dust in the air we breathe is largely composed of organic particles; (2), that they are the germs of plants like the yeast and such-like fungi; and (3), that they are the means by which epidemic diseases are propagated.

The editor of "Scientific Opinion," claims that "each and all of these propositions appear to us incapable of being proved." He claims that a temperature of 212° or higher, such as Tyndall says will in a moment of time destroy them, will have no effect on them; secondly that "observations such as those of Pouchet, Joly, Musset, Mantegazza and others, all go to show that the germs of many of the lower vegetable organisms which are familiar to botanists, are not present in the air generally. Thirdly, the hypothesis that the contagious substance of small pox, scarlet

fever, cholera, and the like diseases" is a vegetable organism, rather than a minute particle of disorganized organic matter, is but an hypothesis and nothing more. So far as it has been attempted to be demonstrated by the experiments of Hallier and others, it has utterly broken down, and the ablest fungologists in the kingdom — Berkley and others — are distinctly opposed to it, as are, we believe, the more scientific of our modern physicians.

ZOOLOGY.

Habits of the Striped Squirrel. — I lately noticed in my garden a bright-eyed chipmunk, *Sciurus striatus*, advancing along a line directly towards me. He came briskly forward, without deviating a hair's breadth to the right or the left, till within two feet of me; then turned square towards my left — his right — and went about three feet or less. Here he paused a moment and gave a sharp look all around him, as if to detect any lurking spy on his movements. (His distended cheeks revealed his business: he had been out foraging.) He now put his nose to the ground, and, aiding this member with both forepaws, thrust his head and shoulders down through the dry leaves and soft muck, half burying himself in an instant.

At first, I thought him after the bulb of an *erythronium*, that grew directly in front of his face and about three inches from it. I was the more confirmed in this supposition, by the shaking of the plant.

Presently, however, he became comparatively quiet. In this state he remained, possibly, half a minute. He then commenced a vigorous action, as if digging deeper; but I noticed that he did not get deeper; on the contrary, he was gradually backing out. I was surprised that, in all his apparent hard work (he worked like a man on a wager) he threw back no dirt. But this vigorous labor could not last long. He was very soon completely above ground; and then became manifest the object of his earnest work: he was refilling the hole he had made, and repacking the dirt and leaves he had disturbed. Nor was he content with simply refilling and repacking the hole. With his two little hand-like feet he patted the surface, and so exactly *replaced the leaves* that, when he had completed his task, my eye could detect not the slightest difference between the surface he had so cunningly manipulated, and that surrounding it. Having completed his task, he raised himself into a sitting posture, looked with a very satisfied air, and then silently dodged off into a bush-heap, some ten feet distant. Here, he ventured to stop, and set up a triumphant "chip! chip! chip!"

It was now my turn to dig, in order to discover the little miser's treasures. I gently removed enough of the leaves and fine muck to expose his hoard — half a pint of buttercup seeds, *Ranunculus acris*. I took out a dozen seeds or so, re-covered the treasure as well as my bungling hands could, and withdrew filled with astonishment at the exhibi-

tion of cunning, skill and instinct of this little abused denizen of our field-borders.

In my boyhood days I had killed many of the little fellows; had unearthed the treasures in their burrows many times; had seen them, as I supposed, under every variety of aspect; in short, I thought I knew the chipmunk, every inch; but here was a new revelation of chipmunk character, for which I was totally unprepared.

It grieves me that I find it utterly impossible with words to convey adequately to you and your readers anything like a complete picture of the motions, the skill, the carefulness, the completeness of effect, and the consequent satisfaction exhibited by this little harvester. I have never read nor heard of any other man's having witnessed a similar scene, nor do I expect myself ever again to witness one. My opportunity for observation was perfect as it could possibly be; for he was so near me that I could almost stoop over and lay my hand on him, while he was half buried under the leaves.

The lesson is perfect; for what our chipmunk does, all chipmunks do, under the same circumstances. Where does instinct stop, and reason begin? Wherein does instinctive, *irrational* skill differ from rational skill? — IRA SAYLES, *Rushford, Alleghany Co., N. Y.*

CONCHOLOGICAL NOTES. — Mr. C. B. Fuller, of Portland, has recently discovered *Littorina litorea* Linn., at Kennebunkport, Maine. Willis records it as being found at Halifax, N. S., and we have always understood it to be common in the Bay of Chaleur. This is the first time it has been found so far south. This species is identical with the common Periwinkle of the English coast, and its increase may be hoped for, as it will introduce a new article of food to our poorer classes. Immense quantities are consumed in England, one firm in London purchasing seventy thousand bushels per annum. They are very prolific and are ravenous vegetarians. Oyster merchants use them to keep down the growth of seaweed in their oyster beds.

For the first time we record the discovery of two species of *Melanians* from Massachusetts. Specimens have been sent by William P. Alcott of North Greenwich, Conn., collected by him on the shores of Lanesboro Pond, Lanesboro, Mass. We identify *Melania Virginica* Say, and *Melania carinata* DeKay.

FUNCTIONS OF THE NERVE-CENTRES OF THE FROG. — Professor F. Goltz of Königsberg has been continuing his observations on the different nerve-centres of the frog. After removing the cerebrum with as little effusion of blood as possible, the frog remained on the table in exactly the position of a sound animal, and without any indication of the injury it had sustained; but, of its own accord, would never change the position once assumed. If pinched or pressed, it would turn itself round, or remove itself by a leap from the external pressure, but would then remain equally unchangeable in its new attitude. It can indeed be induced by external

means to go through actions which it would not ordinarily perform voluntarily, so that to a bystander it would almost appear to have undergone a course of training. Professor Goltz made some curious investigations on the source of the croaking power of the frog. Of its own accord it never croaks when deprived of its brain; but can easily be induced to do so by stroking it softly down the back from the front to the hinder part with the damp finger, every stroke being accompanied by a croak of satisfaction. From a number of such animals a complete concert of frogs can be obtained in this manner. The mutilated frog possesses also the power of preserving the equilibrium of its body. If placed on a book, to which a gradual inclination is given, it climbs to the upper edge, on which it supports itself by its forelegs, and repeats the process every time that the inclination is changed. Under similar circumstances an unmaimed frog would quickly hop to the ground. The movements of the frog, from which the brain has been removed, differ from those of the unmutilated animal in this respect, that they are performed mechanically, and with the regularity of a machine. It would also appear, from these experiments, that the nerve-centres for the voice and for the power of maintaining equilibrium reside, not in the brain, but in the spinal cord. — *Academy.*

THE COMPRESSED BURBOT OR EEL POUT. — In the March (1869) number of the NATURALIST is a paper with the above title by Wm. Wood, M.D. After giving the history, locality, number of specimens and their description, he then says: "The *Lota compressa* probably visits the salt water, as it is taken in ascending the Connecticut, or its tributaries, in the spring of the year in company with fish from the salt water ascending to spawn."

My first acquaintance with this rare fish was early in the spring of 1859. A specimen was brought me from West River, about a mile north of our village, where that stream joins with the Connecticut, and where it was "hooked up" while angling for other fish. Afterwards in 1864, another specimen was caught in the Connecticut River, opposite our village, with a baited hook set for eels. Both were of such extraordinary dimensions (being severally twelve and fourteen inches in length) that I published the fact, because I knew that the specimen of Lesueur, who first described the species was only six inches in length, and that of Storer who gave a description of a second specimen from Ashuelot River was eight inches long. As I had lived many years near these waters, and supposed myself to be well acquainted with their different denizens, and, moreover, had never seen this genus before, not even their fry, I was led to inquire whence they came.

It first occurred to me that they might have come up from the salt water, but the many impediments in the Connecticut, which are such well-known obstacles in the way of the migrations of fish, forbade at once the entertainment of this idea. Be that as it may, an incident has recently come to my notice which may shed some light on their early history, and certainly on one of their species.

On our farm is a swamp of about three acres, from which issues a rivulet, perhaps three feet wide and three to five inches deep. I have known for some years the existence of a peculiar fish in this little stream, for on approaching its banks I have often perceived quick efforts at concealment of something in the dark mud of the little pools along its coast. All my attempts to obtain a full view of the fish proved fruitless, but I judged by the ripples it made on the surface of the water, while passing shallow places that it must be some three or four inches in length. Recently whilst our woodchopper was at work in this swamp, he cut down a tree which fell into one of these pools, and a fish was thus thrown out upon the snow. It proved to be a veritable Lota about three and one-quarter inches long. It resembled *Lota compressa* in every particular, except that its thickness might have been greater in proportion to its length.

This rivulet empties into Whetstone brook, a stream ordinarily about two rods wide and two or three feet deep, and has a bed differing little from that of the Connecticut River. I have lived by this stream a number of years, and have never seen a Lota in its waters. The Whetstone empties into the Connecticut about a mile from the mouth of the rivulet. In this distance are two obstructions, partly natural and partly artificial, one thirty feet, the other twenty feet high, so that it cannot be supposed that there is any egress from the river to the rivulet by water.

The fishes of the Whetstone are *Salmo fontinalis* Mitch., *Rhinichthys atronasus* Agas., *Boleosoma Olmstedii* Agas., *Semotilus argenteus* Putn., *Plargyrus Americanus* Putn., and *Holomyzon nigricans* Agas.; the three latter were introduced by me some twenty years ago. I have been thus minute in giving all possible data, in order that a better judgment may be formed, whether these swamps are the breeding places of *Lota compressa*, or whether the specimen mentioned above may not be a new species.

The train of thought to which a solution of these questions might give rise, would naturally lead us to examine into the effects that purely local or particular causes may have upon the development and forms of fish life. With respect to the size of this specimen, being much smaller than those found in the Connecticut, we may say, that all fish of the same species found in large streams are generally larger than those found in small ones. We have a perfectly analogous example at hand in regard to the *Salmo fontinalis* of the Connecticut, which occurs of larger dimensions than in the Whetstone, the disparity being as striking in the latter case as in the former. — Charles C. Frost, *Brattleborough, Vt.*

A White Woodchuck. — It may interest you and some of your readers to know that I have obtained a perfectly white woodchuck, a perfect albino of *Arctomys monax* of Gmelin. There is not a dark hair on his body or tail, and his eyes are of a clear, rich, carnelian color. He was caught on North-west hill in Williamstown, Mass., and brought to me alive. From the first he fed freely on clover, especially the clover heads,

and made a nice nest for himself from the part discarded as food; in this nest he spent most of his time taking nearly the form of a ball. He always exhibited a readiness to bite, and it was not safe to touch him with the hand. One day I carried him, in his small cage, to my lecture room, and afterwards put him in my private room and left him alone. When I returned I found him out of the box or cage, and bottles and trays of natural history specimens scattered upon the floor. After disturbing things generally he had taken up his position behind a large box of fossils. From his retreat he looked as unconcerned as if nothing had happened. Without much trouble I secured him in his box again, and carried him home and put him in a large cage in my cellar which is well lighted and ventilated. About midway between the top and bottom of this cage is a shelf which touches the bars or slats in front, and extends backwards about half the depth of the cage. This shelf was put in so that the woodchuck might have something to rest upon besides the floor of the cage. After the cage was done it was desired to turn it so that what is naturally the back should be the bottom, the slats or bars thus being on the top instead of at the side; this brought the shelf into a vertical instead of a horizontal position. Now observe what this woodchuck did: he gnawed through the edge of this shelf, which was against the bars, in order to get into the other part of his cage, although there was a space of eight or ten inches below the lower edge of the vertical shelf for the whole width of the cage, and when he was disturbed he often run through this hole instead of going along on the bottom.

I was interested to see that he used everything he could get to enlarge and perfect his nest, not only all of his discarded clover stalks, and the rags which I gave him, but also all the chips which he gnawed from his cage. But he did not get thoroughly tamed, and so availing himself of the absence of a board, which had covered a hole which he had been gnawing, he squeezed out through the hole, scaled the cellar wall, and escaped through an open cellar window. A few weeks afterwards he was killed by a farmer's dog, and I have sent his skin to Mr. Jillson to be mounted.

Mr. Hitchcock of this town, informs me that he has seen a living white woodchuck in New Lebano, N. Y. — S. TENNEY, *Williams College.*

RARE BIRDS IN NOVA SCOTIA. — I observe in the last number of the NATURALIST a note on the occurrence of the *Pomarine Jager* (*Lestris pomarinus*), on the Susquehanna River, Pennsylvania, in July last. On the 4th of October, my friend, Mr. William Gilpin, shot a fine specimen at Digby, on the Bay of Fundy shore of this Province, which is now in my possession. I see in the "Report of the Birds of Massachusetts," that Dr. Brewer also obtained it some years ago in Massachusetts Bay.

Another rare visitor to a latitude so far north, was taken in our harbor about the time of the severe revolving southerly gale of the 30th of January last, the Purple Gallinule (*Gallinula martinica*, Baird). This is the first instance on record of its capture in Nova Scotia. — J. MATTHEW JONES, *Halifax, N. S.*

GEOLOGY.

Gigantic Fossil Serpent from New Jersey. — Professor Marsh describes in "American Journal of Arts and Sciences," under the name of *Dinophis grandis*, a new and gigantic snake from the Tertiary formation of New Jersey. He says "the earliest remains of Ophidia, both in Europe and this country, have been found in the Eocene, and nearly all the species from strata older than the Post Pliocene appear to be more or less related to the constricting serpents. Remains of this character are not uncommon in European rocks, but in this country two species only, one founded on a single vertebra, have been described hitherto, and both of these were discovered in the Tertiary greensand of New Jersey.' The vertebra described "would indicate an animal not less than thirty feet in length; probably a sea-serpent allied to the Boas of the present era."

In closing, the author states that "the occurrence of closely related species of large serpents in the same geological formation in Europe and America, just after the total disappearance in each country of Mosasaurus and its allies, which show such marked ophidian affinities, is a fact of peculiar interest, in view of the not improbable origin of the former type; and the intermediate forms which recent discoveries have led paleontologists, familiar with these groups, to confidently anticipate, will doubtless, at no distant day, reward explorations in the proper geological horizon."

MICROSCOPY.

Microscope Objectives. — A performance of a 4-10 objective made for me by Mr. William Wales, of this city, is of such a superior character that I have no doubt it will be of interest to many of your readers. With direct or central light in contradistinction to oblique, and with the diatom mounted not dry, but in balsam, the *Pleurosigma angulata* is beautifully resolved; the three sets of lines being brought into view with great distinctness, and this with the No. 1 or A eye-piece. Amplification 210 diameters. With no equal power of Powell & Leland's of London, of Hartnack of Paris, of Tolles & Grunow of this country, or of Gundlach of Vienna, various objectives of each and all of which makers I have examined, have either, I myself, or other microscopists of my acquaintance been able to effect this. Another feat which I had recently the honor of exhibiting to several members of the "Bailey Microscopical Club" of this city was a resolution of the podura scale with its light central markings with this same 4-10. The resolution of the striæ on human muscular fibre by a 3-inch objective, also made by Mr. William Wales of this city, again challenges our admiration. — J. J. Higgins, M. D., 23 *Beekman Place, New York.*

[We referred this note to Mr. E. Bicknell, who kindly sends the following reply. — Eds.]

Messrs. Editors of the American Naturalist:—In answer to your question in regard to the above communication, I would say that while fully concurring with Dr. Higgins in his high estimation of Mr. Wales' objectives, I am of the opinion that he (Dr. Higgins) has either made an error in his measurement of amplification (210 diameters with the No. 1 or A eye-piece) or that the 4-10th objective is very much *underrated in magnifying power*. All of Mr. Wales' 4-10th objectives which I have seen have been as near or nearer 1-4ths than 4-10ths in magnifying power; and below I give a table of amplification of such 4-10th objectives as are at hand; also two 1-4ths for comparison:

Maker.	Angle of Ap.	Eye-pieces.		
		1.	2.	3.
4-10 J. Zentmayer, ...	75°	130	210	400
" Smith and Beck, ...	60°	135	220	415
" R. B. Tolles, ...	135°	125	205	390
" W. Wales, ...	110°	175	300	535
1-4 R. B. Tolles, ...	120°	200	325	615
" Smith and Beck, ...	75°	210	340	650

The measurements were made with a first-class stand and eye-pieces of Zentmayer, the image of a stage micrometer being thrown down by a Spencer's camera lucida, and measured at just ten inches from the eye; cover adjustment for 125th cover glass. It seems to me that there should be some uniform standard adopted by the different makers of objectives, so that the 1-4th of one maker may not be as high as the 1-6th of another maker; or a 4-10th of one be as high as a 1-4th of another; or, still worse, a 3-inch objective of one maker of *precisely the same power* as a 2-inch of another maker, which was just the case with two objectives which I had about one year since. If the objectives did not differ any more than the first three in the above table it would be an improvement. The amplification which Dr. Higgins gives to his 4-10ths is as high as the highest 1-4th in the above table. — Edwin Bicknell, *Salem*.

ANTHROPOLOGY.

The Bone Caves of Gibralter. — The four Genista Caves, Martin's Cave, St. Michael's Cave and some others, have yielded evidences of early man, in the form of osseous remains, associated with flint knives and flakes, stone axes, polished and chipped; worked bones, serving as skewers, arrowheads, needles and gouges; anklets or armlets of shell, hand-made pottery, querns, rubbing-stones and charcoal. With these were found remains of numerous animals,* including *Rhinoceros etruscus*, *Rh. leptorhinus* § (extinct); *Equus*, *Sus priscus* (extinct); *Sus scrofa*, *Cervus ela-*

* Those marked thus §, are abundant; and thus §§, very abundant. A single molar of *Elephas antiquus* was obtained many years since by the late Mr. James Smith, of Jordan Hill, in an old sea-beach (now demolished) at Europa Point, the southern extremity of the rock.

phus, var. *barbarus* §, *Cervus dama* §, *Bos* (a large form), and *Bos taurus* §; two forms of Ibex, *Capra Ægoceros* §§; and also the common goat, *Capra hircus; Lepus timidus, Lepus cuniculus* §§, *Mus rattus.* Of the carnivora were determined *Felis leopardus, Felis pardina, Felis serval, Hyæna brunnea, Canis vulpes, Ursus* sp.; also remains of the common dolphin, numerous genera and species of birds, a species of tortoise and numerous remains of fishes, of which the tunny is most prominent.

The remains are imbedded in red cave-earth and also in a black layer similar to that noticed in the caves of France and elsewhere. In many instances the organic remains have been carried down from one cavern to another at a lower level through long fissures, by the heavy autumnal floods which pour from the higher grounds down upon Windmill Hill plateau (where many of these ossiferous caves are situated), bringing with them the remains of the various animals which at an earlier period inhabited the thickly-wooded heights, now entirely destitute of trees and only covered at places by the little *Chamærops humilis.*

Many human and animal remains, attributable to modern periods, have been also met with; but the older human remains are distinguished by peculiarities in the thigh bones which closely resemble those met with in the Cro-Magnon Cave. — *Quarterly Journal of Science.*

ANSWERS TO CORRESPONDENTS.

W. H. S., Hummelstown, Pa. — The "Canadian Naturalist" is published monthly at Quebec, $2 a year gold. Address M. l'Abbé Provancher, Quebec, Canada.

C. J. S., St. Augustine, Fla. No. 1, *Pinquicula lutea*; 2, Nothing came with this number; 3, *Amianthium angustifolium*; 4, *Lupinus diffusus*; 5, *Pinquicula pumila.* See Chapman's Southern Flora. For naming, fair specimens should be sent, — not miserable and withered bits.

J. L. L., Boston. — Specimens of various species of sea-anemones with two mouths, each surrounded by its circle of tentacles, have often been observed and recorded in Europe. I have seen several instances of this kind in our native *Metridium marginatum.* It is, however, to be regarded as an abnormal condition, and appears in many cases to have been caused by some injury, which has been healed, leaving two disks instead of one. Spontaneous division occurs normally, however, in allied coral animals, and a disk-shaped sea-anenome is formed in the West Indies which naturally has two mouths (*Ricordea florida* Duch. and Mich.). — A. E. V.

W. H. S., Hummelstown, Pa. The shells sent are as follows, by your numbers: 1, *Helix monodon* Racket (Stenotrema); 2, *Helix tridentata* Say (Triodopsis); 3, *Helix alternata* Say (Anguispira); 4, *Helix bucculenta* Gld. (Mesodon); 5, *Helix albolabris* Say (Mesodon); 6, 7, *Anculosa dissimilis* Say; 8, *Goniobasis Virginica* Say (Melania); 9, *Paludina decisa* Say (Melantho); 10, *Sphærium sulcatum* Lam.; 11, *Planorbis bicarinatus* Say; 12, 13, *Margaritana undulata* Say; 14, *Unio complanatus* Sol.; 15, *Anodonta edentula* Say; 16, *Anodonta fluviatilis* Lea. — G. W. T., Jr.

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THE HORSE FOOT CRAB.

BY REV. S. LOCKWOOD, PH. D.

It is proposed to give some results of a summer's study on the incubation of the eggs of the Horse Foot Crab, and to connect those results with observations made in an acquaintance of several years with the animal in its native haunts, in the hope of thereby furnishing something towards a life-history of the species.*

Among systematists this crustacean is known as *Limulus Polyphemus*. It bears also the popular names Horse Foot Crab, Horseshoe, and King Crab. In this article these names will be used as convenience may suggest.

The King Crab delights in moderately deep water, say from two to six fathoms. Except in the case of the very young, which are probably carried thither by the tidal flow;

* In October, 1869, the writer read a paper before the Zoological section of the New York Lyceum of Natural History, under the title "A Contribution to the Natural History of the King Crab," which contained the notes taken during the summer's investigation alluded to above. The article now appearing in the AMERICAN NATURALIST is taken mainly from that paper. — S. L.

Entered according to Act of Congress, in the year 1870, by the PEABODY ACADEMY OF SCIENCE, in the Clerk's Office of the District Court of the District of Massachusetts.

it never seeks the shallow waters, unless for the purpose of reproduction. It is emphatically a burrowing animal—living literally in the mud, into which it scoops or gouges its way with great facility. The anterior edge of its enormous cephalic shield is not unlike in form the sausage, or mince-meat knife of our kitchens (Pl. 3, Fig. 12). The upper shell of the animal is composed of three parts—the forward shield, which is greatly the larger, the posterior shield, and the long bayonet-shaped spine, or tail. In the burrowing operation the forward edge of the anterior shield is pressed downward, and shoved forward, the two shields being inflected, and the sharp point of the tail presenting the fulcrum as it pierces the mud, while underneath the feet are incessantly active, scratching up and pushing out the earth on both sides. There is a singular economy of force in this excavating action, for the alternate doubling up or inflecting, and straightening out of the two carapaces, with the pushing purchase exerted by the tail, accomplish both digging and subterranean progression. Hence the King Crab is worthy to be called the Marine Mole.

The Limulus is carnivorous. Its food is the soft nereids, or sea worms; so that not only in its mode of burrowing for concealment, but also in its method of procuring food does it resemble that little burrowing mammal of the land. It is sometimes found held in a strange durance, with a limb entrapped between the valves of the quahog, or round clam, (*Venus mercenaria*). It is a pitiful sight to behold—a galley slave with limb confined to ball and chain—"as far from help as limbo is from bliss." The explanation is easy. The quahog too is a burrower, and Limulus has seized the projecting syphon of the mollusc, which being suddenly withdrawn, the less agile claw is jerked between the valves, and the same are closed. This, of course, would effectually entrap the limb. But here occurs just this strange fact, that a lobster or a crab would not long be held in such durance, but would give their custodian leg-bail; that is, would cast

off, and desert the imprisoned limb, and in due time would reproduce the lost member.

The position of the mouth, and the masticating process are so peculiar, that a description should not be omitted. The King Crab has six pairs of feet; although by some, those constituting the extreme anterior pair are called antennæ, being greatly shorter than the others. The four pairs between this first pair, and the last pair, have a functional structure differing from the anterior and posterior pairs. Of these four pairs, the basal joint, or haunch, of each limb is flattened and smooth on each side, as though they were a series of plates intended to work upon each other, as the keys of an organ under the fingers of the musician. The external edge of each is rounded, and beveled like the edge of a carpenter's chisel. Thus these flattened haunches lie against each other, their rounded edges directed backward at a considerable angle. The beveled edges (which are the exposed parts) of these projections are covered with very sharp incurved spines, overhanging and pointing into the oral aperture; for it is between these four pairs of spine-clad haunches that the creature's mouth is situated. Each of these basal spines is articulated, and is set in the crater, or cup, of a little teat-like prominence. These then, are the true jaws of the animal's mouth; and as there are four pairs of these manducatory joints, the creature's mouth is set in a line between eight jaws. These spiny teeth have, by their articulation, an amount of mobility in their little pits, which is eminently serviceable and preservative. Of these chewing teeth, though the number is variable, an individual can scarcely have less than one hundred and fifty.

Wishing to see what their food might be, and how they eat it, I placed a specimen, hatched the preceding summer, in a small aquarium, and supplied it with plenty of fresh and tender sea lettuce (*Ulva latissima*). But this sea salad remained untouched, although the young Limulus had no other fare for three weeks. In fact, famishment had rendered it

literally diaphanous. I then tried animal food. Having opened a live quahog I routed the little fellow from his hiding place in the sand, and gave it a morsel of the clam. It was ravenous, and fed only as a really hungry being could. Though using the round clam principally, I gave it other food at different times. Any mollusc was acceptable, if only sufficiently tender. It even ate beef; but not with the relish of the mollusca. This I observed, that being well fed it never would eat carrion; although what it would do if impelled by hunger I cannot say.

As yet I had not *seen* the eating. This was also hidden by the carapace. I was now very anxious to witness the feeding process. The first step was to put the animal on a long fast, and thus to secure a good appetite. This done, a bit of clam was dropped before the hungry crab, which was instantly drawn under with its claws, when I immediately turned it over, holding it with the abdomen against the glass side of the tank. It was kept in that position for full five minutes, the eating process being easily witnessed, and the manducation quite satisfactorily observed. The performance is certainly a very curious one. The animal being in its natural position, the food is held immediately under the mouth by the claws, or nippers, of the posterior pair of jawless feet, aided, if necessary, by some of the others. The basal joints, or manducatory haunches, then begin an alternating motion of these members upon the food, by drawing one of the spiny or rasp-like joints against the opposite one of the same pair, the food of course being between the two. This chewing by means of these opposing rasps, reminded me of the hand-carding process, in which the card held by the right hand is brought towards and against the one held in the left hand, the wool being between; when the right hand card is held still, and the left hand duplicates the motion, and so on. The fine particles rasped off by the incurved teeth pass into the mouth. It will be readily seen that food so finely chewed before it passes into the digestive

apparatus would afford but a poor chance to the investigator who sought its nature by use of the knife. Of the large number that I have opened of adult specimens, I never found anything to tell me on what they fed; and not until by actual experiment, above described, did I know whether Limulus was vegetarian or carnivorous.

The exuviation of the King Crab is performed several times during the first year, and at very short intervals. How many I do not know, as that must vary according to the time of hatching. But I think the young produced in the latter part of June will accomplish five or six moults before the cold weather comes. Even in the case of the adult — exceptional as it is among the crustacea — I think it probable that the shell is cast more than once in the year. The professional oysterman having taken up his best crop with the tongs, secures the gleaning with heavy iron dredges; and when using this instrument will take up an occasional Horse Foot, even in the winter season. In the unusually fine weather of an open February several years ago, in Rariton Bay, an adult female was in this manner taken out of the mud by the deep sinking dredge, when lo, the animal had but recently "shed," and its shell was still quite soft.

Sometimes the shedding can be witnessed under very unusual circumstances. A large female taken in August, although kept for many days in the open air, yet moulted in captivity. The operation was a very trying one, and required three or four days, as the animal got very dry. A little water was occasionally thrown on it for pity's sake; and even this was not marine water. Of course moulting under such extraordinary circumstances was a very difficult, and probably painful operation; the wonder was that it could be done at all. With natural surroundings a few minutes generally suffice for the task. A thin narrow rim runs round the under side of the anterior portion of the cephalic shield. This is in fact the widest part of the animal. Just before the time for exuviating a separation occurs

between this rim, and the perimeter of the anterior shield. To the unaided eye this rent is altogether imperceptible, but opens on the exertions of the animal; and at this opening it emerges from the old shell. Now as the opening is at the front, and in the place of the greatest width, and moreover as the shell is sub-coriaceous, and somewhat yielding, and at this particular place is very thin, it may be seen how great advantage the animal has in this matter over the higher crustaceans whose moult, from necessity, takes place from behind, and whose shell is composed of a more unyielding material. In the exuviation of Limulus I fancy a close likeness to that of the insects when leaving the pupa. The King Crab emerges at the forward, but under side of the cephalic covering; the beetle at the forward, but dorsal side of the same. It is plain that Limulus has an easier time in getting off his old coat than his "more respectable relations" have. To see the King Crab, as it were, coming out of himself, is a sight so odd as to draw from those beholding it the exclamation "it is spewing itself out of its mouth."

When the animal, specially noticed above, had come out of its old shell it was nine and a half inches in the shorter diameter of the cephalic shield; while the vacated shell was but eight inches by the same measurement. If they moult more than once in the year this would make their growth quite rapid; and if they do not, it seems to me that they must attain an age of not less than eight years before reaching the size that indicates adult life. But we must speak of this farther on. I have observed that every spring, that is, so soon as the water has lost its winter temperature, large numbers of the young of the previous summer are found in the shallows. These range from an inch to two and a half inches in the shorter diameter. As the creature when beginning life for itself, is but a scant quarter of an inch in diameter, this would imply rapid growth, and I think that the larger of the above have probably lived through two winters.

There are reasons for believing that the spawn is deposited

by the same individual more than once in the same season. I have heard this asserted with confidence by some fishermen. But as they could advance no proof no attention was given it until the following fact occurred. Let me first state that it is a custom prevailing wherever the Horse Foot Crab abounds, to catch it to feed poultry, under the belief that it makes them lay, as it surely does fatten both them and hogs, but imparts a shocking flavor to the flesh of both. The female is always preferred on account of its eggs, of which it has not less than half a pint, crowded within the cephalic shield. These are obtained by inserting the point of a knife into the forward, and under edge of the shield, and running the knife round through the thin rim, already described, when the entire lower part can be torn from the upper part of the shield, thus exposing the eggs, which are like mustard seed, but of an ashy green hue. Now a female that I knew to have spawned in May was in this manner opened in July, and was then to my surprise full of eggs, well formed, and with every appearance of maturity.

The Horse Foot Crab spawns at or near the new and full moon, in the months of May, June and July. By this, however, is only meant that they embrace the time of the extra high tides, which depend so greatly on the lunar influence. But mark the nice calculation herein displayed. They come up at a great high tide, advancing on the bottom, until they reach a suitable spot near to, but within the extreme line of this great tide. Three definite advantages are in this way secured. First, the spawning is performed under water, or without undue exposure; second, the line of the average high tide is thus selected; and third, a short exposure to the daily low tides is thus secured, by which the proper exposure of the spawning spot to the development-accelerating heat of the direct rays of the sun is obtained.

A visit of the adult Limulus to the shore line, except at the spawning season, is a very rare event. At this season they come up in great numbers in pairs; and it may be said

with no figure of speech, in true nuptial bands,—the male riding on the shield of the female, and retaining himself firmly in this position by holding to the sides of the posterior carapace, with the two stout and short nipper feet, which are exclusively possessed by the males, which with the size of the animal, so much smaller than the female, serve to distinguish the sex at a glance. The female excavates a depression in the sand, drops her spawn into it, upon which the male emits the fecundating fluid, and the nest is at once deserted, the parents returning seaward, with the retreating tide. Occasionally, a pair less alert than the rest, is left by the tide, which, however, they will overtake, if unmolested. By the action of the water the eggs are immediately covered up with sand; though if the wind be unpropitious, large numbers are often washed up, and cast in windrows on the beach, and soon devoured by the many hungry beings, of bird, fish, and mollusc kind that always abound.

Our Limulus is a true monogamist. But it is likely that a new mate is accepted each spawning time. Occasionally a female comes to shore with even three suitors attached, two of them vainly endeavoring to unseat the accepted one. The above has led to the belief among fishermen of a disproportion of the sexes. I think that this point cannot in that way be inferred.

Though formerly the Horse Foot Crab was very plentiful in Rariton Bay it has become rather scarce. Accordingly they have to be watched for now. Not having the time to spare I engaged a fisherman to keep a lookout in the month of May, 1869, for an actual spawning. He was instructed to see the pair come up and spawn, and to capture them at once on their attempt to return with the tide; he was also told to scoop up with a tin vessel the whole spawn-mass, sand and all, and not to touch the eggs with his hands. I believe the man faithfully obeyed instructions. Thus the spawn and the parents were brought to me uninjured. My preparations had been carefully made. Hatching jars had

been set for a number of days, and the water was in a fine state of oxygenation. One difficulty I had to submit to, of a serious character. I could only subject the water to the reflected light of the sun. The direct light would in the summer season prove too warm, and spoil my water. The result, as will appear, was that the hatching was accomplished very slowly, a fact which with another should be borne in mind while reading the following, namely, the absence of those conditions of agitation, variation of water depth, and sometimes complete exposure to air and sunlight, consequent on the tidal flow.

May 26, 1869.—To-day my Limulus eggs were set for hatching. Yesterday was full moon. The eggs were of a greenish white, dull, and rather dirty looking. My notes record no measurement, which I now regret. As incubation progressed the external shell became rapidly darker, and more coriaceous. But for this last fact I had become afraid that they were in process of decay. Several ineffectual efforts were made to get at the internal changes, but owing to imperfect instruments I gave up in despair, and determined to watch and wait for more advanced developments. There is considerable vitality in the King Crab's eggs. It will bear a good deal of retardation, and yet come out at last. It will be understood that necessarily my arrangements had a good deal of retarding effect. At the real amount I was quite surprised. Those on the surface progressed most rapidly.

July 18th.—Thirty-four days after spawning. The opaque chorion has cracked (Pl. 3, Fig. 1) disclosing the white pellucid spherical membrane within. Now a sight met me which gladdened my eyes. It was a living trilobite form. But of course very diminutive. Yet it could be seen with the unaided eye, and quite satisfactorily with a common lens. It is shown greatly magnified (Pl. 3, Fig. 2) in outline. Here the elongate character of the abdominal posterior is noticeable; also the excessive relative width of the thorax.

The figure shows only the upper side, but it has the feet quite advanced, and the two great eyes have well begun. In two or three days it was considerably changed (Pl. 3, Fig. 3). Though not so much, still the cephalo-thorax was relatively greatly in excess of the abdominal shield. The limbs, though not shown in the cut, were quite long, reaching beyond the edges of the carapace. The two sessile eyes were now prominent, but the central oculiform tubercles, as they have been called, but which I prefer to call ocelli, were wanting; for in their place, that is, the central anterior of the cephalic shield, was still a depression, or cleft, yet to be filled up in the progress of development. To me it seems that so far the development was markedly asaphoidal; that is, it reminds me of Asaphus, using that term as the typical genus of the Trilobites. Before passing, it should be observed that the embryo had its two segments inflected; and with short intervals of rest (not many minutes at a time) kept up a very active revolving within its pellucid prison; the effect of this friction on the walls of the hollow sphere would be to bisect it. As the embryo revolves it lies upon its back.

August 3d.—Seventy days from the spawning. To-day an embryo has left the ovum. It measures two and a half lines in length and two lines in width. Except for a little space in front the cephalic shield is armed on its perimeter by a series of briar-like spines, in two rows of about twenty-five each, the spines alternating with some regularity as to size. The curved rim of the pygidium, or caudal shield, is also fringed, but with setaceous tufts, each tuft being made up of hairs of different lengths. This new-born creature is in outline almost circular. The cleft in front of the cephalic shield has disappeared. The sessile eyes are now prominent, and are well up on the shield, the two ocelli are quite distinctly marked. But as yet there is nothing of the articulated tail that marks the parent Limulus, or its congener Eurypterus.

Such was the form (Pl. 3, Fig. 4) of the little being be-

fore me. Was it not a veritable trilobite? It at once began to shift for itself, making a persistent effort to burrow like its parent. By consulting the figure it will be seen that besides its tail-less aspect every feature is that of a trilobite. The abdominal, or caudal, carapace is relatively much wider than in the adult Limulus. The segmentary lines afford a very distinct trilobed character to both shields. The spiny and setaceous fringe finds its counterpart in many of the trilobites. The pointed tendency of the keel on the caudal shield seems to me to look towards Pterygotus. But if we take into view the presence of the ocelli already, and the high-up position of the large sessile eyes, we have Eurypterus shadowed forth. Let the reader examine Pl. 3, figs. 5, 6, 7, 8, 9, 10, which give an outline of the telson-plate, or terminal tail-joint of as many separate species of the fossil crustacean *Pterygotus*. Fig. 5 is *P. Banksii*, in which the telson is marked by a cleft. Fig. 6 is *P. bilobus*, showing the cleft less marked, and the presence of a median ridge or keel. Fig. 7 is *P. gigas*, in which the keel is more developed, showing a higher relief, and a greater prolongation, and the disappearance of the cleft. Fig. 8 is *P. Ludensis*. Here the keel is still more acuminated, and the plate itself is mucronated. Fig. 9 is *P. bilobus*, its size being very much reduced. Fig. 10 is *P. acuminatus*. Here the keel has attained an extreme length, and great relief, and is with the plate carried to a slender point. And this prolongation of the telson plate into a terminal spine, is, I think, in respect of posterior development, the highest effort of the Pterygotus. I also think that this is shadowed forth in the embryology of Limulus. But it should be noticed that there is not so far, in all this spinal tendency, anything in the direction of an articulated spine. That is, there is nothing xiphosuroid, or sword-tailed in all this, as in Limulus, and the fossil crustacean Eurypterus, which have an articulated bayonet-shaped appendage. Now Pterygotus has two sessile eyes, and only two, and these are placed low down on the very edges of the

forward shield. But Limulus and Eurypterus have both two large sessile eyes set high up on the shield, and two ocelli set forward.

The want of an articulated tail was soon apparent in the case of our little Limulus. The slightest obstacle turns it on its back, when, not having this organ, which the adult uses so effectively in such emergency, the little thing begins a vigorous flapping of the branchial plates. This causes it to rise in the water; then by ceasing the agitation it at once descends, with a chance of alighting right side up. Should it miss the ascent would be repeated until its desire was accomplished.

August 15th.—Eighty-two days from the spawning. A great many had hatched, and many had perished for want of care. I had almost given exclusive attention to the one described above. It had its second moult to-day. A few minutes sufficed for it to withdraw itself from its baby suit. I noticed that it stopped a little while, as if to rest, having the caudal appendage only half withdrawn from the old shell (Pl. 3, Fig. 11). At last out it came, a person of distinction possessing the articulated rapier. It is a true Limulus now, and fully entitled to carry for life, the sword of honor, which has ever been the family mark of rank. The animal is now quite a fourth of an inch in width, and its tail is the one-twentieth of an inch in length. Where did it keep it while in the old dress? It must have been bent under and upon the abdomen. I have noticed them since at this moult, with the tail considerably incurved, and which required some hours to straighten out. Dorsally the little thing has now nearly the complete appearance of the adult Limulus. The setaceous fringe of the abdominal carapace had disappeared, and had left an armature of teat-like or half-developed spines; and the spiny fringe of the cephalic shield was quite gone. The posterior projections of this shield are now sharp. The tail is distinctly articulated, but somewhat stumpy. A section of the adult tail would be al-

most triangular, the lower side being slightly rounded, the upper sharply edged, while a section of the tail of this young specimen would be almost ovoidal. The tail of the young is also more distinctly marked with lines of segmentation than is that of the adult. As it travelled on the mud before this moult, it made tiny rows of toe-tracks, leaving a plain unmarked space between the rows. Now it moves with tail depressed, and makes a medial line dividing the toe-tracks into two series.

Alas, at this point, when I had become intensely interested, a serious illness, against which I had offered a dogged determination to keep at work, peremptorily settled the matter by taking from me the use of my eyes.

It will be noticed thus far that the observations here recorded, are almost entirely morphological, and not physiological. Professor E. D. Cope has given us a lucid phrase, "expression point." He says of development, "while the change is really progressing, the external features remain unchanged at other than those points, which may be called *expression points*." It seems to me that "expression points" of generic significance have been pointed out four times in these remarks. Twice in the ovum I thought there was an "expression point" of a trilobed genus; and in the larval stage, I thought Pterygotus and Eurypterus were shadowed forth.

And in the metamorphoses of the larval state there are remarkable changes with reference to functional necessities. Already mention has been made of the moult at which the animal receives its articulated tail. Now in the life of Limulus this tail is as indispensable as is the Alpine stock to the Swiss mountaineer. It is constantly liable by the least agitation, or obstruction, to be turned on its back, when but for its tail it would be as helpless as a tortoise in the same position. It is then that it deflects the tail, and inserts this sharp spine into the mud or sand, and after a few persevering efforts succeeds in turning itself over. So feeble are

its limbs that exposure of the under side to the attacks of fishes would soon end its career. In short it must keep its carapace "right side up with care," if it would care to live.

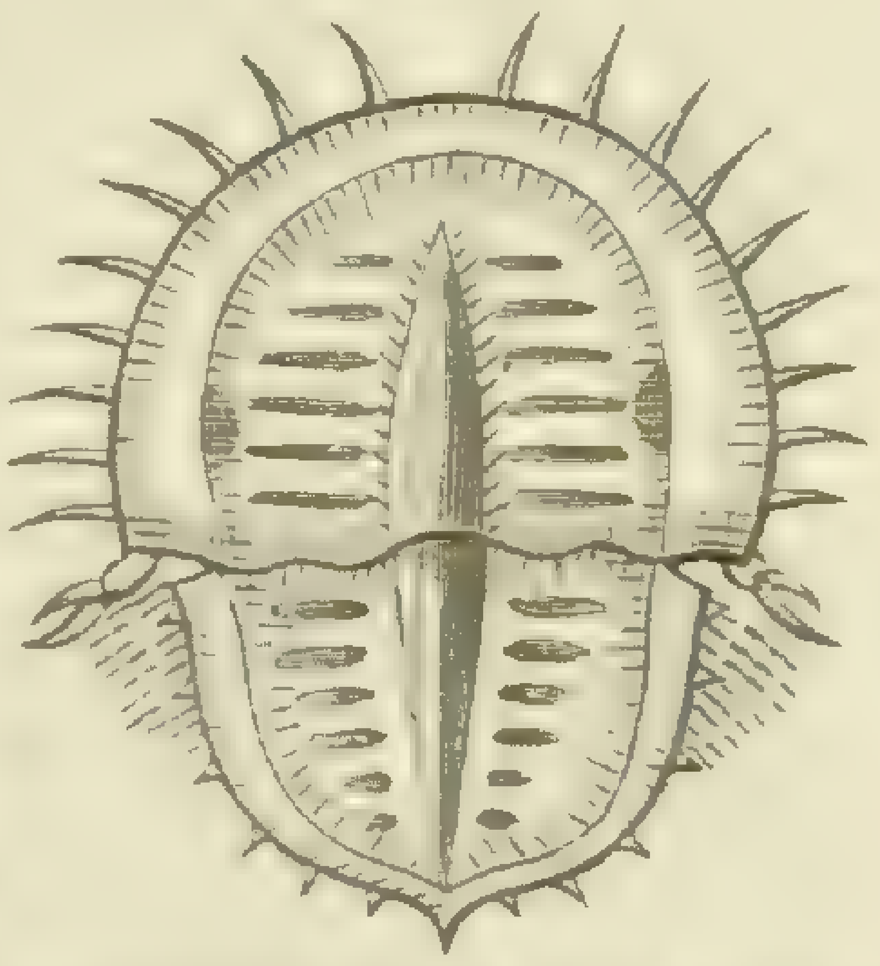
I must now mention another functional metamorphosis which seems to me of a very remarkable character. So great is the difference in form between the anterior feet of the female, and the same feet in the male, that the very children on the shore lines at once in this way distinguish the sexes. In the female this limb is long, slender, and weak; in the male short, stout and ventricose. Intended for strong holding, their nip is like that of a vice. Their use is to hold on to the carapace of the female, so that the male may retain his position as the pair come up in the breeding season. And so strong his hold that no violence of storm, or attack of rival suitors, can displace him. Well does the fisherman know this, as he stands in the water ready to spear the female as she comes up in nuptial embrace. He is only concerned to catch the female, for it would need some force to separate the two. Now functionally, this stout foot, "or hand," as the fishermen call it, has no use in early life. The Horse Foot Crab has its period of puberty; this is its adult stage. But judging from the size of the males when they couple, which is pretty uniform, and their actual rate of growth, I think that the puberty of Limulus cannot come before the third or fourth year. And it would not surprise me if the latter figure should prove the minimum age. However this is the point—it is not until that age of puberty is reached that the male undergoes its last metamorphosis. It then has a moult, from which it emerges, having received its large claws, or literally, its nuptial hands. What change there may be on the emotional side who can tell, when master Limulus assumes the *toga virilis* and is old enough to "propose." This may be asserted of these very decorous and monogamous people, that among them premature marriages are unknown, for however soon the lady may be ready to give her heart, not until maturity of age can the gentleman possibly extend to her his hand.

The above fact was obtained by evidence purely negative, yet not the less convincing. First, there was the suspicion of the fact, then the search for a young male possessing nuptial claws. But albeit the numerical equality of the sexes this was not found, though large numbers of young specimens of different ages were examined. Moreover, I have not found the fisherman who has ever seen one.

Although some of the systematists make of Limulus a distinct order, as *Xiphosura*, or sword-tailed; yet I cannot but think that in nature the Trilobites are included, making of all one grand order. It would thus have not only a real systematic meaning, but a profound chronologic significance. However this may be in the light of coming knowledge, I think Pterygotus and Eurypterus stand higher than the typical Trilobite proper, and that Limulus leads rank over all.

Figure 68 shows Limulus after the first moult (very much enlarged), when not more than a week old. The fringe of the buckler is now less thickly set, the cardinal spines only being conserved, and these not so stout. The posterior shield shows the permanent spines. Still the contour is asaphoidal while the median ridge of the abdominal carapace, terminating in the point of the mucronated shield, is suggestive of the dorsal keel in *Pterygotus gigas* and *P. anglicus*. At this stage, as the facts seem to me, the larval Limulus shows forth more than one generic "expression point" in the career of the trilobite as a "comprehensive type."

Fig. 68

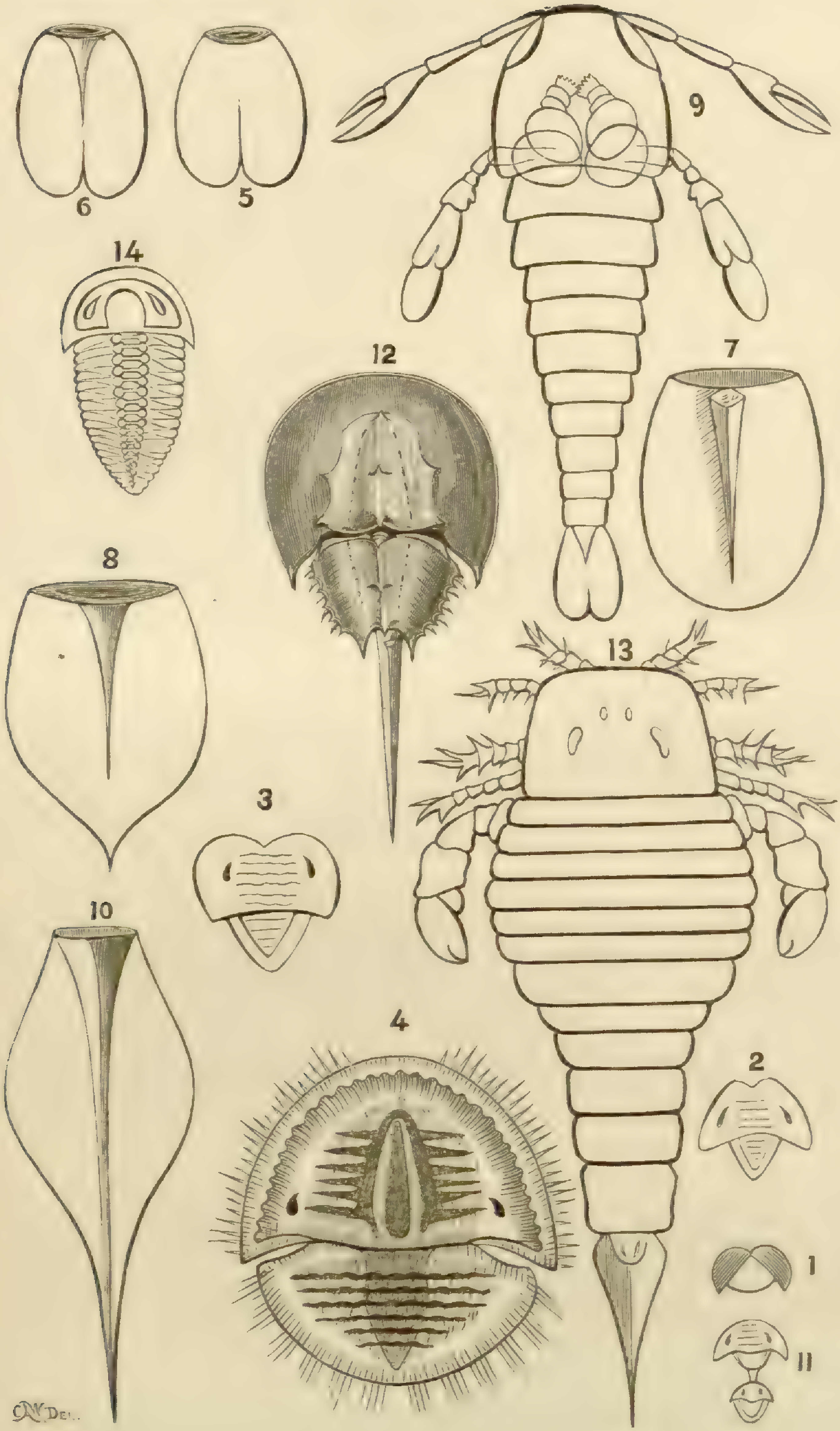


Limulus after the first moult.

It should be stated here that the exuvia represented by fig. 68 was accidentally discovered on the surface of the mud, at the bottom of an hatching jar, used in these observations last summer. At the close of the warm season last year my jars must have contained not less than two hundred young Limuli. We have already said that so soon as

hatched the young burrow like the adult; hence the rareness of an opportunity to witness the casting of the skin. Hoping to continue observations upon the growth of my interesting family the ensuing year the jars were carefully put away. Little regard, however, was paid to temperature, which, on several occasions, went down to the freezing point. On the 3d of May, 1870, I emptied the jars to see how my charge was getting on, when lo, not one of the last year's hatching was alive! but wonderful to say at least a dozen little fellows, all hatched this spring, and all alive, had taken their place. With these were also at least thirty eggs, in different, but all in advanced, stages of incubation. In some of them the young could be plainly seen revolving. The fact was these eggs had been at the bottom of the hatching jar, and had never had any contact with the sunlight. At once, not without some misgiving as to the result, the proper provision was made to complete the incubation, namely, new sea-water, clean sand, the eggs put on top, and all set in a favorable place. With an ordinary hand lens the progress of incubation could be observed daily. At half-past four o'clock on the afternoon of May 11th, before my eyes, a new-born baby Limulus left the egg. Just think of it—these eggs are within two weeks only of being a year old! And then how remarkable are these facts also—those eggs were partly incubated last summer. Hence there has been not only a remarkable retardation of development, but also an actual arrest of the same for seven or eight months without sacrificing life. Query: is there any connection here with that indomitable persistence of being, which in the Divine will has carried this comprehensive type through the many EONS of existence, wherein has been unrolled so slowly the life plan of the Entomostraca, from that initial Trilobite of the Pre-siluria to our Limulus of these latter days?

It has been hinted already in this article that at different stages of its life the larval Limulus made a different impress



LOCKWOOD ON THE HORSE-FOOT CRAB.

when it walked. While tailless there were simply two parallel sets or rows of toe-tracks, but when tailed those parallel rows were separated by a median line, showing the caudal trail. Is there not here a caution for the interpreters of the "Protichnites" seeing that the same species, at diverse ages, may make widely different tracks?

Not more than three or four exuviæ were found entire in the mud of the hatching jars. In all the rest the buckler and the pygidium were separate. Now it is not the case that the Horse Foot shells, in the long wind-rows on the shore-line, are entire. The entire ones are decidedly exceptional. Before certain tides the young are helpless; but the adult never comes shoreward except to spawn. Hence their exuviæ are brought up by the wash and the under-tow of storms, thus effecting the separation of the two parts. Is there not here an explanation of the great abundance of the pygidia, or caudal shields, of the *Asaphus Iowensis* in the Iowa limestone rocks? I do not regard them as the debris of dead trilobites but as their cast-off shells. They are the tidal windrows of that ancient sea. The articulation of the two carapaces was no doubt feeble; and the specific gravity of the pygidium less than that of the buckler. In this case the debris would be sorted into different depths of water. The bucklers would be less crowded, because in greater depths where the tidal action was less; while the lighter pygidia would, by the same law, form the drift of the shore-lines.

EXPLANATION OF PLATE 3.

Fig. 1. Egg of Limulus just cracked by incubation, showing the pellucid sphere.

Fig. 2. Embryo in the egg, much enlarged.

Fig. 3. Same two days older, much enlarged.

Fig. 4. Young Limulus just out of the egg, enlarged nine diameters.

Fig. 5. Terminal tail joint of *Pterygotus Banksii.*

Fig. 6. Terminal tail joint of *Pterygotus bilobus.*

Fig. 7. Terminal tail joint of *Pterygotus gigas.*

Fig. 8. Terminal tail joint of *Pterygotus ludensis.*

Fig. 9. *Pterygotus bilobus.*

Fig. 10. Terminal tail joint of *Pterygotus acuminatus.*

Fig. 11. The smaller one is Limulus just hatched, natural size, mere outline; the larger is the same undergoing the first moult, and leaving the old shell, and having a tail.

Fig. 12. Limulus Polyphemus, one year old. The markings on the posterior carapace become less distinct with adult age. The adult female will attain a size even exceeding twelve inches across the cephalic shield.

Fig. 13. *Eurypterus remipes;* size very much reduced.

Fig. 14. *Sao hirsutus*, a trilobite.

THE SEA-WEEDS AT HOME AND ABROAD.

BY JOHN L. RUSSELL.

THE vegetable productions of the ocean, like those of the drier portions of the earth, are subject to a similar order of distribution. The most common collector of plants becomes soon aware that there are kinds which are not to be looked for in ordinary places, and soon learns to set a value on those which rarely occur to him. He also desires to extend the area of his observations so as to embrace different latitudes, or to obtain the same results by ascending lofty mountain heights. So the collector of sea-weeds does not confine himself to particular districts, but endeavors, either by personal inspection or else through the labor and courtesy of others, to ascertain what forms, seemingly familiar or entirely diverse, may grow abroad. The deeper soundings of the ocean-beds, like the higher elevations of the land, afford him a greater variety, affected by different causes, which in their natural course produce different results.

The general plan of vegetable life, especially in the lower plants, seems to point to constant modification of some one typical form, and this modification appears to have its origin in climatic influences. It becomes a most fascinating study to endeavor to join the separate and divided links so as to

possess, in a series of specimens, the probable method of development which nature has thus instituted. Let me endeavor to adapt this idea to the thoughts of this present essay, and arrange to some extent the sea-weeds (*Algæ*) of our own and of foreign or distant coasts together. Let us see in what kinds there are corresponding ones; and when we select some choice specimen from the beach-drift, or pluck it from the rocks, endeavor to tell on what distant strand it is obedient to the pulsing waves, or perchance attracts other eyes.

The coast of New England presents as great a diversity in outline and in character as perhaps can be found in the same length of the Atlantic shore. We have here the deep inlets like Norwegian fiords in Maine; the bold rocky promontories of Massachusetts varied with the almost level and smooth sands of the South. The noblest in size, as well as most beautiful in color and features, are the algæ which are to be met with throughout this wide range. The would-be successful collector must resort to the dredging apparatus, and like the shell collector needs a strong arm and abundance of patient toil to serve him; else he must wait some violent storm, which shall break from their deeper moorings those more valuable weeds which only can grow perfectly and develop themselves entirely far below the surface, where the sun's rays but feebly penetrate and the water is of a nearly uniform temperature. Some wonderful waifs are occasionally met with in this way by visiting the beaches and picking over the waste with scrupulous care. In the warmer waters of the Southern States, like those on the Florida Keys, there may be sought singular kinds resembling corals, for which they were formerly mistaken by Lamouroux, some of exquisite beauty in design and shape. Some of these are found growing from the base of a Gorgonia or sea-fan, and secreting from the ocean their covering of lime. And others of richest green creep over the sand beneath the water, and throw up a turf as verdant as that which clothes

the most luxuriant pastures. This field of botanical enquiry is yet open, and many a desirable harvest can be reaped, from season to season, out of the treasures of the deep, and the yet undiscovered or little known species of New England attract the deserved attention of the casual visitor or of the sedulous student.

Let then the season be summer, the warm days of June, when many people as naturally resort to the seaside as if the custom were instinctive and migratory. To some the scenery is the same and familiar, and the cool air is the main thing to be realized; to others, though familiar yet ever new, and to others every object, however minute, is novel. The very rocks and cliffs are different in looks, composition and general features; the sand composed of curious minerals, tiny shells and comminuted fragments; the wild flowers wierd and unusual; the thick leaved and prickly seeded plants thriving within the spray's reach; the beach cumbered with productions of the sea — mineral, animal, vegetable — thrown in wild confusion. Who, for the first time, is not moved with wonder at these sea-weeds? Who would not wish to become better acquainted? And no wonder so many are gathered, floated out into shape, dried, pressed and carefully laid away, silent witnesses that beauty and utility are often combined where little dreamed of. The interest increases with each coming season; the practised eye soon learns to discriminate; the cultivated taste finds the most propitious time of the year for collecting, and such trifles, employed at first to while away an hour or two, are often found indispensable and auxiliary to the very enjoyment of life.

Suppose we start on a walk for some gravelly beach contiguous to some town or city, and removed from it by the interventions of wild pastures, rocky and almost desolate, or by some level, wide extended marsh. At any season of the year, when walking is practicable, the botanist who accompanies you, can point out abundant objects of interest long before you come within sea range. The intervening

space proves not so dreary or desolate as it appears, for often our most interesting and best friends have the rudest exterior. Perhaps he knows something about the lichens, those dull green, grayish, yellow, bright orange, black crusts, scales, fringes, torn, ragged felts; or perchance those dry, crisp, brittle, crimson tipped, blunt tipped, sharp pointed, branching anomalies which cover many an acre of sterility where nothing else grows, and where the surfaces of rocks and the rough bark of trees cannot offer them any chance. He will be able to introduce you through these desiccated and seemingly lifeless plants, the lineal descendants of the first forms of vegetation which appeared on the dry and solid earth, to the wonderful and more grotesque, more developed, sometimes enormous sea-weeds which, at the birth of Creation, sprung into activity as plants in the "waters which covered the face of the deep." Nay, you need not heed these unless you choose, although within every one of them lies enfolded a wondrous tale, locking up in the recesses of their natures, health and healing and joy. Notice too as you walk, the fair flowers springing up on every side. If autumn, or early winter, a bright October's day or a green Christmas, you may yet find for your admiration such seed-vessels, such starry calyces, such feathered down, such inimitable trifles as no gold could purchase or art fabricate.

Such rough and confused pasture lands lie between Rockport and the sea; between Gloucester, between Marblehead, Cohasset, Scituate and many famous places, and the beating ocean. By the very marge of one such beach I have found plants seen nowhere else by me except on mountain sides. Think of Rockport in July, lovely in the masses of mountain laurel, and this fine native shrub opening its clusters of flowers within sight of the very sea. From the land side the very odors of Araby the Blest come over the Manchester and Gloucester waters from the magnolia, and gladdens the heart of the returning fisherman. The very rocks, worn smooth by the surf and rounded and polished, extend

just so far inland, which the closely attached lichen defines by its persistence in bright yellow colors in the strict line of terrestrial and maritime growth. They stand there patient sentinels to denote that the floods shall no more cover the earth; the lichen the earth's plant, and the alga the sea's plant, approximate and almost kiss each other in approach. Nothing higher in the scale of organization ventures so near; not the sedge, bulrush or hardiest grass dare grow so close to the waves. Nor are lichen and alga far removed in consanguinity; in structural difference something; some more exposure to sun and rain, to snow and ice, to heat and cold, in existence and continued individual life vastly more in favor of the little crusted slow-growing lichen, patient, untiring, serenely beautiful, doing by day and night its usual work and breaking down the hardest and most obdurate rock formations by the gentlest persuasion of its constant presence to aid the atmospheric influences.

The algæ are so diverse in their forms, and so many in number, computing only the precise kinds or species, to say nothing of innumerable varieties, many of which have been separately and minutely described, that in order to facilitate the labor of finding out what they are it has been found best to divide them into three great groups known by the color of their seed-vessels. But as it is not always possible to find their seed-vessels, or even those minuter parts which though not seeds serve for similar purposes, because like other plants, and what we call flowers or flowering plants, these too have particular seasons of the year when they produce them, so to look for strawberries after the vines have done bearing would be precisely like looking for seed-vessels on sea-weeds when they had passed the season. Some kinds, too, like some other and higher plants never bear any seeds in our latitudes, but such seed bearing plants must be sought elsewhere. Fortunately in this dilemma the chances of success are in our favor, and the usual color of the sea-weed corresponds with the color of the seed it bears. The rosy or

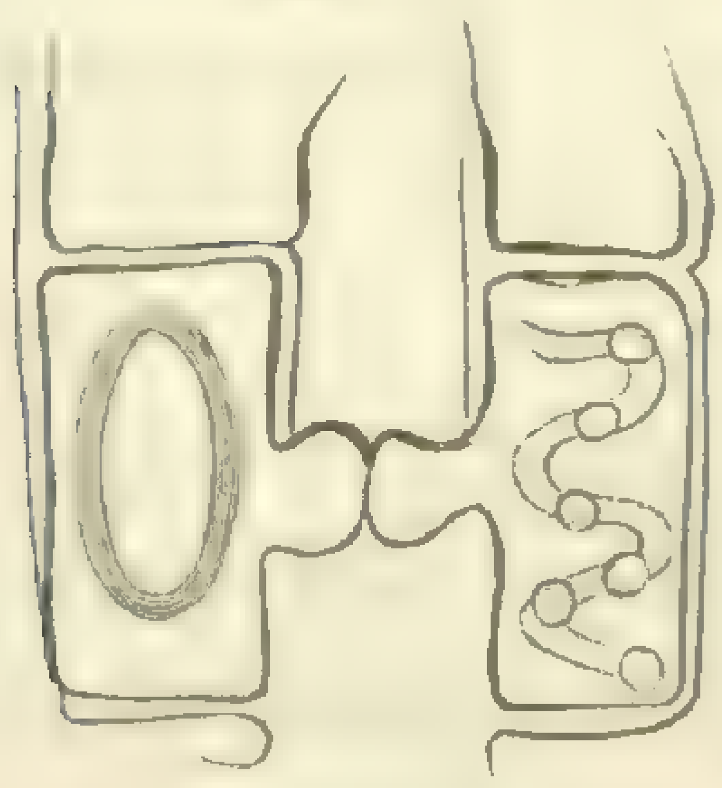
red-seeded algæ are usually the most popular because the prettiest; but others, even the black or fuscous-seeded algæ have many claims on our attention. I will venture, however, to set both these kinds aside for awhile, and speak first of the green-seeded algæ, the *Chlorospermæ*, as they are called in the books.

In the rear of some beaches, like that known to the old folks about Marblehead, as Devereux's beach, perhaps it has now another name, surely none more euphonious — may be seen large extended reaches of salt or brackish water, covered with floating masses of a light-green tangled fibre, and which lies in flakes upon the tips of the growing grass, or cast ashore to desiccate and fade in the bright sunshine. Lifting carefully a little on the end of a sharply-pointed stick we shall find a great many silky, glossy threads, each slender, sparingly branched with alternate and scattered branchlets somewhat spread apart; sometimes growing on one side, each joint several times longer than broad. Within each joint look after a green granular mass which answers for seeds, and to do this you must have a pocket lens for your eye; at home a compound microscope would do better, and in this rapidly growing and widely extending Chlorosperm you have taken your first lesson, perhaps, in studying the algæ, having been introduced to the *Conferva flavescens*, and if possessed with farther curiosity you may learn of other Confervas of equal or surpassing evidence. The extreme lightness which these sheets of dead fibres have, renders them easily elevated into the higher strata of the air, whence they have been known to fall in violent showers far into the interior, spreading consternation by their presence in such an unusual manner, and greatly frightening the superstitious and ignorant. Sometimes this substance has been called "meteoric paper," and I have seen in the microscopical cabinets of my acquaintances fragments of similar matter from very remote parts of the globe. This single species has been observed extensively in Europe and

America; and the few students of our native kinds have been rewarded by meeting with several others, identical with species which grew on the other side of the Atlantic Ocean, such as *C. bombycina*, *rivularis*, *aerea*, *refracta*, etc. But perhaps the most curious of these water silks, as they may be termed, credited to the northern lakes and to those lovely sheets of fresh-water in Central New York, is the *C. glomerata* of the earlier writers, but now called Cladophora, on account of the peculiar manner in which the joints arrange themselves, being either packed together in strata or layers, or flexed and curved in long and delicate lines; and another, far more curious, of which there are many sorts distributed from Sweden in the far north, to Cayenne in South America; found in Cuba, in New Zealand, in the lakes of Germany and in the fresh-waters of Great Britain; and worth looking after here, is the *C. ægagopila*, its filaments rolled together like a compact ball, and when dry, sometimes used for pen-wipers. I have looked for it, but always in vain; other delicate and pellucid-jointed water plants sometimes do so, but evidently they are only imitations. In the ditches and by the sides of shaded paths where the water is stagnant, similar Chlorosperms may be seen. Is there any identity and do the same algæ grow indifferently in fresh and salt water alike? The question is worth attention, so let us when we retrace our steps examine. Here I have lifted on the end of my cane some of these floating, swollen masses; they also are fibrous and silken, but see! how different is the green coloring particles within the joints! Here are a few in which the seeds are so arranged that the joints which are only about as long as they are broad, and vary in length, are marked by two roundish stars. It is but a rude idea produced by the arrangement of the seeds, but as these stand side by side in the parallel joints of two of the silken filaments of the tangle we have lifted from the ditch, and which are joined laterally by a connection or bridge, they remind us of the mythological story of Castor and

Pollux, the twins of Tyndarus, and our humble alga is accordingly called *Tyndaridea*, and of it are many kinds growing tangled even, in the same mass. In similar and

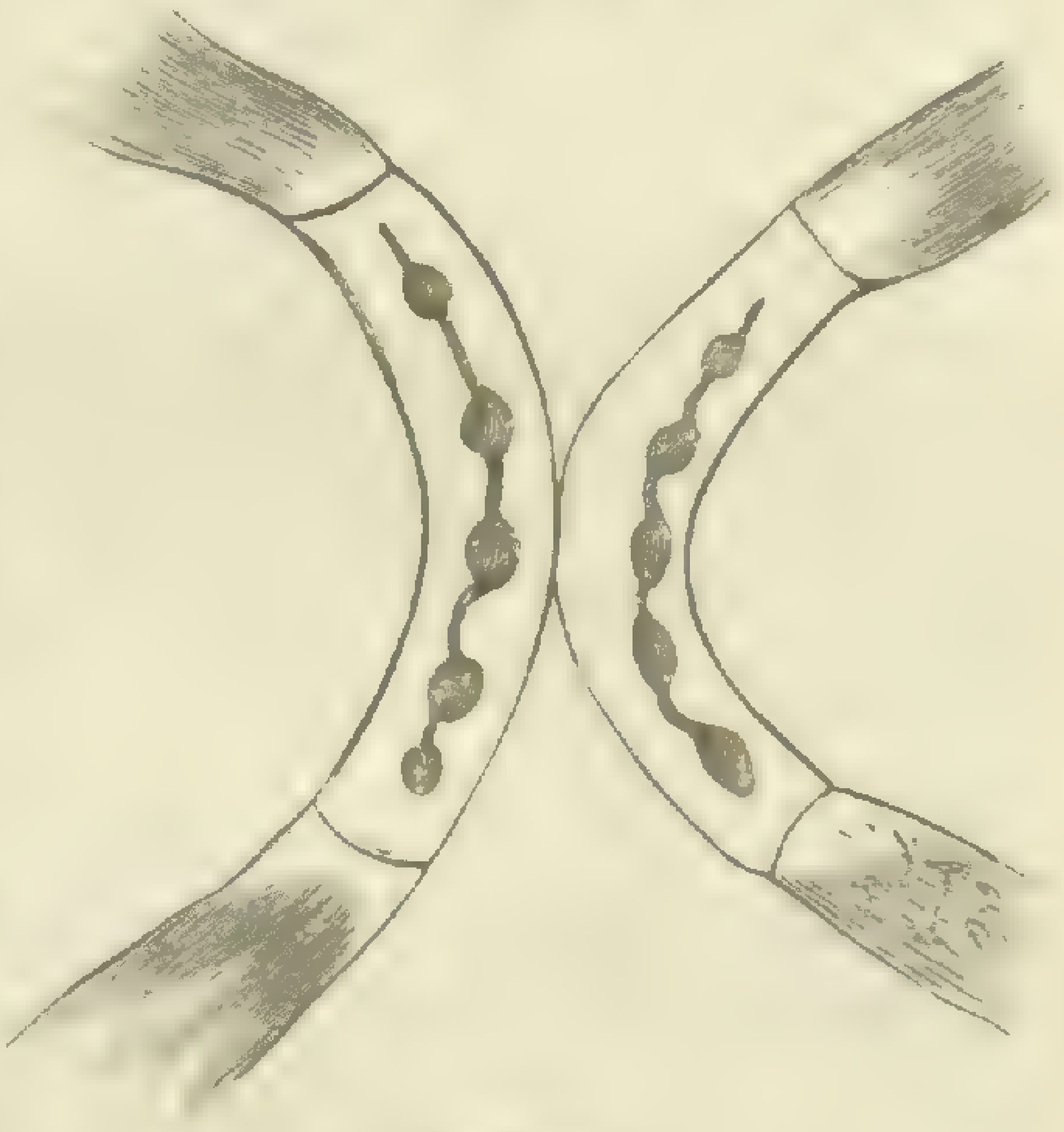
Fig 69.



Zygnema.

equally unlikely places for beauty to dwell and abide we can gather the *Zygnema*, or Yoke-thread, in the joints of which the green granules are at first arranged in spiral rings, but afterwards collect into a single globule as the future seed (fig. 69). In one species the spiral lines become a series of the Roman V, and in another of the letter X. Strangely, too, do the delicate and fragile filaments or silken threads bend at acute angles, the coloring matter first filling each joint, but soon contracting into a narrow continuous stripe. In this and others of similar behavior and appearance we have *Mougeotia* (fig. 70), named in memory of a botanist, and bearing his surname. They are common in Europe and New England. Before we leave these rich green, emerald and vivid, or pleasing green weeds of the stagnant and brackish pools, let

Fig. 70.



Mougeotia.

me tell you of a pleasant surprise I once had in the sunny waters of an overflowed and stagnant pool formed by the rising of the lake, and there permanent through the year for want of means of draining it. Years have fled and the pool is solid ground now, covered by the property of the railroad company, and near Burlington, Vermont. The conchologist may be pleased to learn that *Lymnæa megasoma* Say, once lived there; but my finding the elegant water-net, or *Hydrodictyon utriculatum*, previous to its being seen by the celebrated Bailey in Philadelphia and at West Point, will always

connect a delightful remembrance with stagnant pools and still waters in my mind. In this pretty aquatic the joints are united at their ends into regular pentagonal or hexagonal meshes, and form a tubular net which floats in the water. Turning again towards the sea let us look into these salt pools among the cliffs, some shallow and others deep and lined with exquisitely colored algæ too. Certainly, so far as looks go, some of these verdant and glossy silks should be Confervæ, but having been instructed better by the lens let us see what it will do for us here. This flossy silk, how delicately and gracefully it floats just under the surface, but a little of it lifted into the air collapses in a very ungrateful way. Yes! you have gone out of the realm of the Confervæ and only resemblances occur. Thus your floss silk, so entangling, inelegant in the air, shows its elegant proportions and finer divisions in its native elements and in water of a denser medium. It is a tuft of a true maritime Chlorosperm (fig. 71), one of a very large genus, and as Professor Harvey tells us, difficult to define; so we must be content with our present knowledge to observe and admire. Some tufts of darker green colored and bristle-like jointed filaments stand stiffly in the water; they are worth gathering, and bear the name of *Chætomorpha*, or Bristle alga; the most common with us is the *Melagonium*, but several others may be found on the New England shores and the Mediterranean, the Canary Isles, Algiers, New Holland, Tropical America and the East

Fig. 71.

Chætomorpha.

Indies; the northern and southern portions of the globe delight in their presence. For specimens they only dry indifferently, the joints shrinking by dryness, but the algologist cares little for looks. Very marvels are those closely adherent algæ, which creep over moistened surfaces, and some of which are found on rocks wetted by the sea, many in springs of flowing water, some in hot springs, and such unlikely places; but I should scarcely forgive myself if I overlooked in this connection the *Microleus repens* (fig. 72), in masses resembling a green slime of almost black intensity; but lifted from the wet path and a few of its conferva-like threads magnified, shows its claim to regard. As the little bit expands under water the microscope assists you to see the oscillating motions of its jointed filaments, creeping apart from each other like the measured progress of the hand over the dial plate of your watch!

Fig. 72.

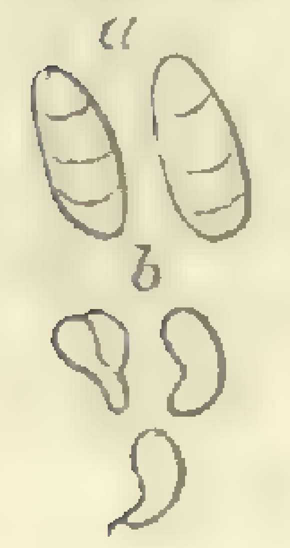
Microleus repens.

Similar, but not tied up in little sheathing bundles, are the pretty *Lyngbyas*, snarls of silky fibres, but each in a mucous sheath by itself and divided into numerous transverse joints of rich deep green, purple, brown and other colors; widely diffused over the globe and extensively scattered over wet surfaces, faces of rocks, and places where we should expect nothing curious or striking. They too, boast of many kinds of residence in the sea, in salt marshes, among pebbles on the shore, in hot springs, and the water of salt works, living alike in fresh or saline homes.

Some few larger and more specious Chlorosperms are those rich green crisped and wavy-margined thin algæ, which lie upon the soft mud after retreating tides, covering unsightliness with continuous beauty, and refreshing the eyes. They are known as "lavers," *Ulvæ*, and two or three species are well known. They do not make very pretty specimens, but pieces of them can be advantageously employed in arranging

other kinds. Sometimes they are served up with lemon juice under the name of Oystergreen, and as a diet are considered of good repute. The broadest leafed kind are selected. The green particles which correspond to the seeds are deeply embedded in the pulp of the entire plant, and commonly arranged in fours, while those of the Purple laver (*Porphyra*), which notwithstanding their color, so distinct from the seeds of the Chlorosperms, form an exception to the general rule, and though possessing rounded granules, quaternally arranged, are also provided with clusters of oval seeds (fig. 73) besides thus indicating a step forward in the progressive development. To find this pretty alga it is well to examine the piles and timbers of wharves, and the perpendicular faces of rocks submerged by the tides. Other and finer species than our own have a wide dispersion, and in common with the green lavers may be frequently met with, abroad, in similar situations. Not very unlike their cousins, the Ulvæ, are the grotesque looking, pale green, inflated bullate Enteromorphas, tossed in wild confusion, and mingled irrespectively together, with the usual rejectamenta of the sea upon the rocks; despised and overlooked as they are apt to be there they are respectable Chlorosperms when growing and thriving under the water; and a little care and attention to their merits will give them their place among the dried trophies of the ocean gleanings. Singularly alike, and yet different, are the *Tetrasporas* of the fresh-water, floating quietly upon the stream, their lax netted tissues of pleasant green color having their interior substance dotted over with clusters of seeds arranged in fours; and others of humbler pretensions but of wondrous symmetry and beauty nestling like small disks upon the pebble or upon the submerged log, or throwing wide upon the current their elegant beaded filaments like necklaces of strung jewels, embraced by the Chlorosperms or claimed by aberrant forms of the Confervæ.

Fig. 73.

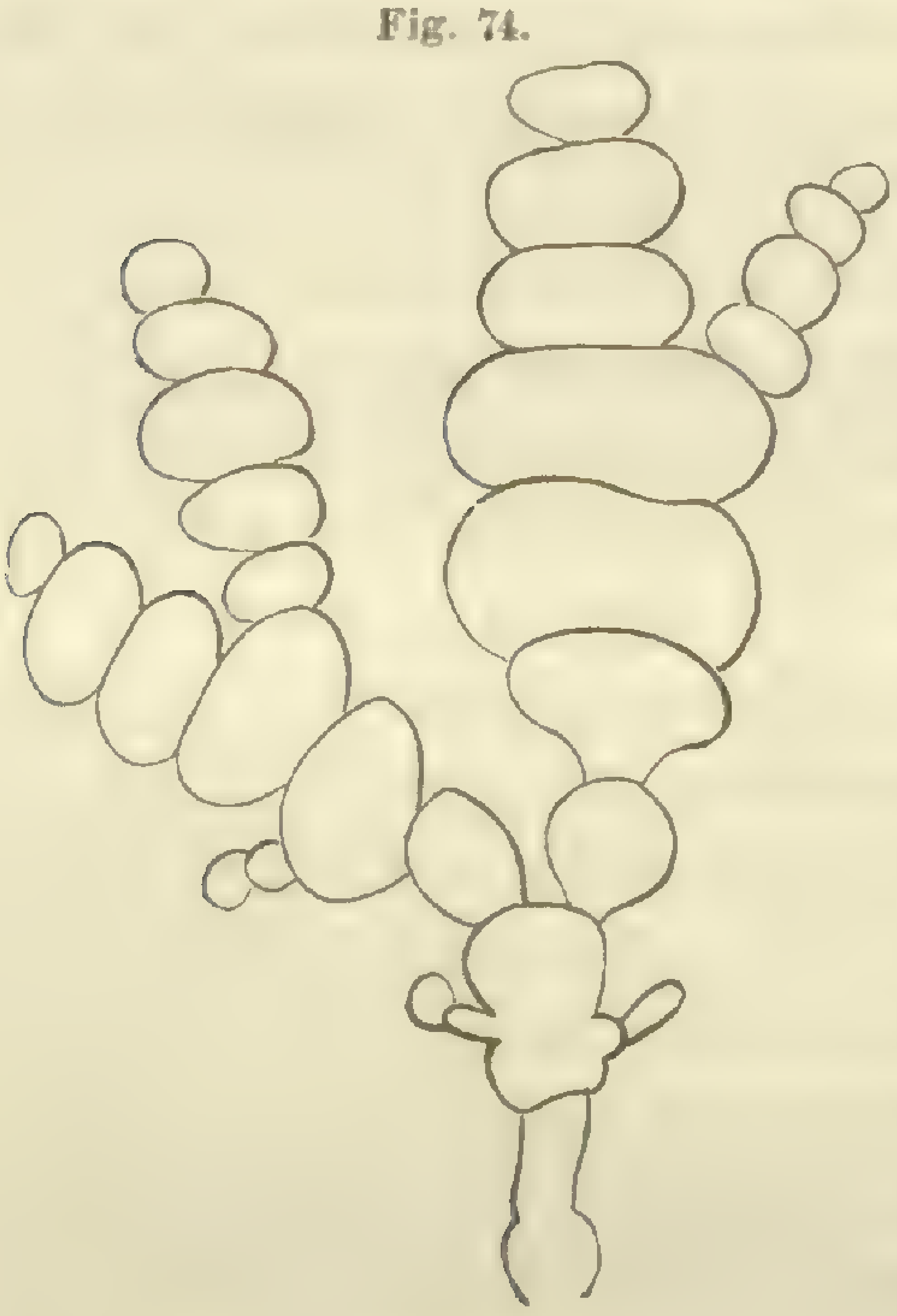


Seeds of Porphyra.

Some tropical sea-weeds belonging to this section now claim the attention. These are the Siphonaceæ, so-called because whatever be the form or size of the alga the different parts have a continuous cavity throughout like a pipe or siphon. And a very great difference exists in these several forms, some of which are very singular, others very beautiful. They are described as green, marine or fresh-water algæ, either naked or else coated with carbonate of lime, which they extract by the method of their growth and life from the water. A few kinds, of which the elegant *Bryopsis* is an instance, are found in our northern bays and waters. It is a pretty little green-tufted feather-like alga, parasitic on other weeds, and growing on the rocks near the shores. Yet in its range it reaches to Cape Horn, the Falkland Islands and New Zealand. The green particles within its substance break up into smaller parts, and bursting through the sides of the branches escape to furnish the needed seed dispersion. In a somewhat similar branching kind, but in which the single jointed filaments and branchlets or twigs, as we may call them, are compacted together into flattened bundles, so as to look like a rude fan furnished with a handle or stem, and the sticks somewhat encrusted with carbonate of lime, we have the *Udotea*, named by Lamouroux after some ocean goddess, known to Hesiod. One species, the *U. conglutinata*, of Lamouroux, has been seen growing at Key West; and another, in which the lime is uniformly and evenly deposited on the entire surface, much more resembles a spread-out fan, and is known in our tropical seas as *U. flabellata*, while other seas produce still other forms. They are so bizarre and unlike ordinary algæ that no one but an adept would recognize their place among sea-weeds. In *Halimeda* (fig. 74) we have still other singular and anomalous looking plants, short-jointed and broadly dilated for the length of the joints, looking not unlike some smaller truncated cactus of the green-house, but soon fading to a dull white tint, and on drying becoming brittle. Several species are met with

on the Florida shores, of which, perhaps the *H. opuntia* is the most common, as I have picked several fragments of its clustered stems from gorgonias and corals collected among the Keys. Removing the lime encrustations, a singular skeleton of fibres, branching off into clusters of smaller branches, presents itself and which serves as a support to the tissues. In company with these oddities is another singular marine production, composed of innumerable slender, single-celled branching filaments, inextricably woven together into the form of a hollow ball, and which grows from the size of a cherry to that of the human head, and is known in the European seas as *Codium bursa*, or Sea-purse; while another species with a narrow, long, branching form, but with fibres similarly entangled and woven, has been found on the coasts of California, but is not known on the Atlantic shores of New England, a prize perhaps for some sea-weed collector! Of the other siphon-constructed algæ may be cited the *Caulerpas*, elegant, green, creeping-rooted algæ, mimicking under graceful forms, the ferns, club-mosses, feathery mosses, ground pines, selagines and other higher cryptogamic plants, such as grow in the woods and in bogs remote from the sea; investing the submarine sands and tide-washed rocks with perennial verdure and loveliness, and found alike in every tropical sea on the globe.

Fig. 74.



Halimeda.

These lime-bearing algæ so far away from our personal observation, and to be seen only in our most southern latitudes, should have some representatives on our northern

shores, and it is to the Corallines and their allies that we will turn for farther enquiry. Leaving, however, unwillingly, the attractive Chlorosperms we will make some acquaintance with the beautiful family of the Rhodosperms, or rosy-seeded algæ, plants corresponding in the tints and colors of their external and internal arrangements, with the elegance of their seed-vessels and seeds. In outward habit the Corallines present also considerable variety from the simplest and lowest in the mode of increase similar to that of the crustaceous lichens, spreading in horizontal concentric circles, or gradually developing upwards and outwards in the form of stems and branches. On every part, encrusted in their lime covering which moulds itself to the joints, swellings, depressions, ridges, or into the flutings and channels of the surface, or surmounts the very tips in the form of seed-vessels, one would scarcely suppose that these elegant marine productions — so abundant in every tide pool, and fringing the deep cool grottos beneath the water-covered rocks, or lining with patches of pleasing and varied colors their sides, or laying down tessellated and mosaic pavements, by encrusted pebbles presenting to the vision variety springing from their secreted cements — were sea-weeds and marine vegetation. But an immersion in diluted mineral acids dispels the mystery; the usual tender and flaccid tissue of cells and pulp appear in due proportions beneath the covering which looks so much like the fabrications of the polyps, and in the absence of microscopical investigation these innocent plants were described and figured as animals related to the corals, and from their smaller size and comparative insignificance were called Corallines. Very rarely found in the colder seas the one species best known at the north is the *Corallina officinalis* (fig. 75), once in fictitious repute in medicine. You cannot miss it, growing as it does in the pools left by the tides, and to be picked from the beaches attached to some shell, most usually the larger muscle (*M. modiolus*), thus indicating its range even in

deeper soundings where that mollusk abounds. A much more slender and delicately jointed kind, scarcely more than simply branching, is the *Jania*, presenting under the surface of the ocean a violet green tint, which soon changes to a more or less deep rosy or red, and finally becoming shining white if exposed to the air and light, growing parasitically on other sea-weeds and widely distributed. Some elegant species are known in Cuba and on the southern coast of the United States, and others are found in the oceans about Australasia, Cape of Good Hope, etc. The *Amphiroæ*, also widely distributed over the globe, are lime-bearing Corallines, the joints cylindrical, separated from each other by bare portions of the horny axis, the seeds lodged like those of all the Corallines in conical wart-like conceptacles, the different parts of the little plant on which these occur furnishing some criterion to determine its real name. Beautiful and interesting as they seem in living condition, a more intimate examination assists in revealing their curious structures. Having in this excursion for northern lime-encrusted sea-weeds stepped into the domains of the Rhodosperms, or rosy-seeded algæ, let us take leave of our verdant acquaintances, and cultivate the friendship of a higher series of marine plants, whose seeds and seed-vessels are more curious, elegant and diverse.

Fig. 75.

Coralline.

The algæ in this order are by far the most universally attractive of any of our native kinds. That part which looks like their foliage, and is technically called the *frond*, is liable to a great difference in size, shape, and outline, in some being broad, or flat, or narrow, or thread-like, the main stem frequently dividing, or the disk-like support on which it rests suddenly spreading and ramifying upwards, the branches often arranged in regular pinnæ, or lateral wings,

and these again dividing into smaller branchlets; or the broad, thin, membranous leaf throwing out similar but smaller ones from its edges; the seed-vessels often displaying much beauty and elegance of design, and variously distributed in the leaves; add, too, that gathered at almost any season, they make pretty specimens for the album, either as portions of the plant or even as fragments, it were no wonder that equally with the child and the adult the Rhodosperms become favorites, and are considered foremost among the wonders of the sea.

Attracted by the brilliant crimson feathery bit which now comes riding on the crest of the wave, the attempt to secure it as a prize is successful. It came from deep soundings, and has been torn off from the friendly support of some gigantic kelp, by a sudden swell or rude wind. Thousands of just such bits, and some of them several inches long and broad, you can pick out of that drift high up on the beach. It is the *Ptilota serrata*, and though so common here, should you chance to gather algæ on the coast of California you will find it there, the denizen of the Atlantic and Pacific alike, while those who collect for amusement from the beaches of Rhode Island, New York, New Jersey, etc., may find another, *P. elegans*, likewise found at Beverly and its neighborhood, a smaller and softer plant with jointed pinnules. On the tips of the main branches, and enclosed by the curving of the smaller, are lodged the pretty conceptacles or seed caskets, giving the plants a feature of interest. The species of Ptilota are not numerous, but they are found in most parts of the world. A still more beautiful fragment is this which I have at this moment rescued; I find it frequently with the last but seldom can I find a perfect piece, such as is now lying on my study table at home, from the English coast. In outline and ramification a little like Ptilota, but its dichotomous branches are two-edged with a sort of thickened midrib, its color a dark lake, and it dries into good shape. It has two kinds of seeds, some growing

in the pulp of the frond in clusters (*tetraspores*), the others issuing from conceptacles which grow on the outside of the smaller branches. On the French coast it is called *P. vulgare*, or the Common Ptilota, and Kützing says that it occurs in the Atlantic, Pacific, and Southern Oceans.

The Carrigeen moss, so well known in the preparation of food, and to many more familiar on the table than on the shores of the ocean, is the *Chondrus crispus*, really an elegant alga. It is subject to many varieties, and the best way to study them is to go down as far as you can among the rocks at low tides and see the plant growing. A careful drying of some of the most prominent sorts will repay. Those gathered from the beaches are more or less bleached or discolored, and generally filled with sand. In similar situations, and even growing where the water is always deep, some other algæ similar yet distinct may be sought. Like others which grow out of reach except by the dredge, they are thrown ashore in tolerable perfection during storms. Of these the *Phyllophora membranifolia* may be cited, the fronds as much as a foot long when fully grown, the stem cylindrical, filiform, irregularly branched, the branches expanding into fan-shaped flattened membranous leaflets, the color a rich purple, inclining to livid, while that of the European species is scarlet. The *Gymnogongrus* which inhabits similar situations might be mistaken for the Chondrus, looking not unlike some variety of it, but its internal structure forbids this. Something like twenty kinds are known in the world, and the one most seen in this neighborhood is *G. Norvegicus*, having an extensive northern distribution.

These black tufts growing out of the stems of the larger algæ, and from the outside of shells, etc., belong to *Polysiphonia nigrescens*, of which the curious student could find a great many distinct varieties. A section of the frond would exhibit a number of tubes, side by side, composing the branch, and indeed the entire plant, and those tubes vary in

number, and yet seemingly not in a capricious manner, in different tufts. Though thus inelegant and vulgar or common, they belong to a refined and delicately educated family, having in their circle some of the prettiest algæ known in the American seas, of which the Venus' Comb (*P. pecten-Veneris*) found parasitic on corals and shells at Key West and the Pine Islands, is a notable example; and indeed all require only to be magnified to show what they are. There are numerous species to be looked up on the various sea-weeds and marine objects on which they delight to grow. This almost gelatinous mass of dissolving threads staining the paper with a deep empurpled or crimsoned blotch, is the *Dasya elegans*, more commonly met with to the south of Cape Cod; it is likewise a parasitic alga and grows in deep water; nor are other beautiful species unknown in distant regions. *Rhodomela* is worth looking for, being an elegant, much branched, filiform, cylindrical-stemmed alga, of which *R. subfusca*, *gracilis*, *Rochei*, etc., have been collected on the coast of Massachusetts. The several species belong to temperate zones. In the English manuals much is said of the beauty of the *Lawrencea;* in this country this alga is represented by the *Chondriopsis* of J. Agardh, and some may be sought, of which *C. Baileyana* is really elegant and graceful, while its conceptacle, or seed-vessel, is of classic outline, minute, yet not to be overlooked! Others similar might be alluded to, but we must defer mention of them, unless we meet them in their coral groves in waters of a higher temperature.

The broad-fronded rosy sea-weeds claim a passing tribute. Our beaches and shores, the resort of summer seekers for pleasure and profit, offer us the *Delesseria* with a genuine rosy-red, leaf-like, jagged edged, or else delicately branching membranous symmetrical frond, with a percurrent midrib. The seed-vessels are to be looked for near the midrib, but definite spots containing another sort of seeds occupy the surface or portions of the frond besides. Several species are found both north and south, but by far the finest is the *D.*

Americana, dedicated to Henry Grinnell of New York, in honor of his noble conduct in an expedition fitted out by him in search of Sir John Franklin, and known to American botanists as the *Grinellia* of Professor Harvey. In *Nitophyllum* we have a ribless frond, traversed by slender irregular veins; the frond broad membranous and variously divided, the seeds in the form of dots deep in the pulp of the leaf. *Calliblepharis ciliata* has the margins of its rich dark red frond beautifully ciliated or fringed; *Botryoglossum* and *Hymenena* are California species and can scarcely be looked for with any degree of success hereabouts. The *Rhodomeniæ*, with *Euthora*, are plants of great beauty, and need scarcely more than be named as the species are few; *R. palmata* is parasitic on algæ in shallow water; *R. palmetta* on the larger kinds in deeper soundings, and *E. cristata* extends in its range from the Arctic coast to Cape Cod.

Among the most abundant of these rosy-seeded algæ, and likewise of the most delicate structure, we notice the *Ceramiaceæ*, with fronds growing in close tufts, but sometimes solitary, creeping along the surface by fibres or affixed by disks, the stems slender, thread-like, articulated, dichotomously or pinnately branched, and sometimes growing so interwoven as to form network or spongy masses. In some species the space between the joints is diaphanous, which gives a strikingly beautiful appearance; in others the joints exhibit no such peculiarity. The species are exceedingly numerous, and the search for rarer ones in any given district would be compensating to him who does not despise trifles such as these at first seem.

The last of the Rhodosperms to which we invite your attention is *Callithamnion*, a very large genus of beautiful algæ, mostly small and many even minute, the different species difficult of determination, subject as they are to constant variation. The elegance of their several parts in stem, branches, and branchlets, the delicacy of their subdivisions, their exquisite color and the symmetry of the seed-vessels

in spite of the obstacles in correctly addressing them by their correct names, attract the attention of the most superficial. They are not difficult to find, and the same efforts to secure other and more specious kinds will insure many of these.

The Melanosperms, black or fuscous seeded sea-weeds, less comely and attractive but by far more useful to savage and civilized man alike, remain for a cursory glance at least. Although our species are of only a respectable size when compared with foreign kinds, yet they assist so much in producing the effect we witness, wherever the ocean impinges on the land, we can illy spare them. Investing rock and wood structures alike, if built in places subject to the variations of the tides, they bear exposure of a few hours to the dry atmosphere or scorching sunshine, and revive as the cooled waters return to cover them, forming safe retreats to fishes, mollusks and other marine creatures, and affording the most nutritious dressings by way of manure to the exhausted fields. The variety of forms which they present has caused them to be comprised in several families with subdivisions arranged in such a way that they can be more readily studied, and those will claim our notice. About our shores the most abundant sea-weed of this kind is the *fucus*, of which there are two or three species and several varieties; or according to Professor Harvey five species on the American and seven species on the European shores, and one allied to *F. nodosus*, found at the Cape of Good Hope. They are usually known as kelp weed, rock weed, etc. Their seeds are lodged in tubercles filled with mucus, and they are discharged through the small pores; the hollow vesicles by which they are buoyed up in the water are not the seed-vessels but air bladders. A section of one of these seed tubercles, under the microscope, affords an instructive and pleasing sight. The *Halidrys siliquosa* might be readily taken for a narrow fronded fucus, but the air vessels are singularly divided transversely by numerous diaphragms extremely thin and

membranous. It is usually found in shallow pools, but where the plant is never left to even temporarily become dry. Though very common on the Atlantic shores of Europe it does not seem to have been recognized here as growing on this side of the ocean. The *Cystoseira*, too, is only recognized as American in a California species though several are known to the British waters, and the *Phyllospora Menziesii*, detected by Menzies himself when with Vancouver, has elsewhere as yet only occurred in the deeper soundings of the California coast. In this plant we see the same globular air vessels we have noticed in the fuci. To this family belong also the gulf weeds, *Sargassum*, a vast genus and of which some species extend as near as Nantucket and Providence. One of them, the tropical Sea-grape (*S. bacciferum*), is seen floating in masses in the gulf stream, and is a familiar object. Kützing gives us a list of one hundred and three distinct species known over the globe!

An excessively branched and bushy mass of dark brown fibres, covered with short harmless prickles, and sometimes growing several feet in length, often presents itself on the sandy beaches, evidently torn from the bottom of deep water. This is *Desmarestia aculeata*, so variable in appearance at different stages of growth as to have led good botanists astray. When young, this otherwise stiff, bristly weed is clothed with the most delicate pencils of finely divided filaments, of a beautiful green color, a condition worth seeking. Its mode of bearing seeds is unknown.

Another natural order of the Melanosperms, comprising a great variety of kinds, is the *Laminariaceæ*, among which—from a simple cylindrical threadlike frond of the diameter of a whip-cord, and often twenty, thirty or forty feet in length, tapering at the extremity, and fixed at the base by a disk (*Chorda filum*) to a frond of broad dimensions, and supported by a long stalk (*Laminaria* or oar-weed)—we find a series of modified forms in species found in our waters. Of the sea leaf (*Thallasiophyllum*), one of this order, a writer

and naturalist thus speaks: "The ocean hardly boasts of a more beautiful production; it is generally about the height of a man, very bushy and branched, each branch bearing a broad leaf at its extremity, which unfolds spirally; a spiral border winds round the stem; a number of rather long, narrow perforations, arranged in a radiate form, give the frond the appearance of a cut fan; the margin is entire, its substance coriaceous, but liable to be torn. No seeds have been detected. This fine fucus, or sea-weed, is plentiful around the whole island of Amaknak, clothing the rocky shore like a thick hedge, and forming at a little distance a very pleasing feature in the scenery." (Mertens as quoted by Professor Harvey.) Though destitute of this wondrous sea-leaf, our piles of seawrack can display something similar in the highly curious sea colander (*Agarum Turneri*), which has come ashore after strong winds and gales. Furnished with a short, compressed, coriaceous stem, widening and flattening as it approaches the frond, and clasping by its stout fibrous roots the rocks and stones, its dark olive green expanded leaf perforated at short intervals with roundish holes, it is quite a respectable weed. The shores of Kamtschatka and the Pacific recognize others. Besides several kinds of the oar-weed of respectable dimensions, such as the Sweet or Sugar, the Long-shanked, the Fingered, with its frond deeply cleft into several strap-shaped segments, we have for noble sea-weeds *Alaria esculenta*, known, as articles of food, under the name of murlins among the peasantry of Scotland and Ireland, belongs to a small genus, inhabits the colder regions, and is recognizable by a branching root, stalked, membranous frond, with smaller fronds or leaflets springing from the stalk and below the main frond. A definite dark colored patch in the centre of these leaflets indicates the clusters of pear-shaped seed-vessels packed vertically among straight and simple threads.

From these we come by easy transitions to some of the most marvellous vegetable productions on our globe, and

algæ, or sea-weeds, too. How insignificant appear our kelp-weeds in comparison with the *Lessonia* of the Antarctic Zone, trees with forking and branching trunks covered with crimson brown, sinuated edged, and jagged-toothed leaves, or with blackish opaque foliage and twisted flexuous trunks, growing like submarine forests; or with the *Nereocystis* of the Aleutian islands, whose stem, never thicker than a packthread, extends to the length of forty fathoms or more, and expands at the summit into an inflated cylinder from which issues a leaf, which gradually grows wider near its top; not singly, not here and there a plant but areas of great extent covered with innumerable plants; or with the *Macrocystis* whose slender stem and numerous leaves are buoyed up by their expanded and swollen base, the stem so long that fifteen hundred feet has been reported by observers as within the limits of belief. These several kinds of expanded fronds are employed as utensils among savage people, while the trunks of many of these gigantic algæ drifting on desert shores have been mistaken and gathered for fuel, supposed to be actual wood.

The structural arrangement of the cellular tissue on a number of the Melanosperms, giving to their fronds a peculiarly netted appearance when viewed through a magnifying glass, suggests a natural order, called *Dictyotidæ*, which signifies like a net. Externally there is quite a variety among these sea-weeds, and of them we may search for *Punctaria* in two species. both parasitic on other and larger sea-weeds about Boston Harbor, or even *Asperococcus* with an inflated frond, while the others delight in a flattened one. The seeds may be found in the minute dot-like clusters scattered over the surface of the plants. To this order belong the curious *Padina pavonia* and its allied *Zonaria lobata*, bearing no inapt resemblance to those richly zoned and velvetty fungi which grow out of old dead tree-trunks; but both these lovely algæ are tropical and belong to our most southern states. The rest of the Melanosperms are either parasitic and minute, and to be gathered either accidentally or else

though strange and unusual in exterior, so infrequently that they hardly claim our present attention. In the structure of their seed-vessels and seeds they are objects of curious interest and beauty, but require a quick eye to detect the condition favorable to secure specimens, which when collected, must be submitted to the microscope to satisfy the enquirer.

If our excursion and lesson has convinced us that in the distribution of plants, the ocean, which to many, shuts out the chance of minute observation, forms no exception to the law of vegetation; each part of its vast bosom bearing, like the earth, its appropriate flowers, plants and fruits, a day or two among the sea-weeds will be well employed.

FOOT-NOTES FROM A PAGE OF SAND.

BY DR. ELLIOTT COUES, U. S. A.

If those whom fashion and the weather drive from city follies and vices to the vices and follies of the seaside; who live in hotels and carriages and fancy the society of their kind the only sort desirable or possible,—if such read at all by the sea shore, it is not from the broadest and most eloquent page before them. With eyes to see, blind; deaf, with ears to hear; to them, a blank, a void, beyond the titillation of social scandal. Others go out of doors afoot, looking and listening; in every object by their pathway a familiar thing; with every vibration of the air, a well known voice; with every odour a reminiscence. *Alone* by the sea? There is no solitude—no escape for the naturalist, even though in a weak moment he wish it, from a multitude—no disentangling of self from the web of animate creatures of which he is one slender thread.

The sea, we know, is teeming with life—full of shapes

useful or curious, beautiful or monstrous; the waves themselves, in ceaseless change, incessantly battling with the land, seem life-like; but the sand itself, solid and motionless, looks lifeless. The great broad sheet that stretches along the coast seems to be now, as it always has been, inanimate. A vast bed of silica; and yet if not alive, what a sarcophagus it is of myriad lives since perished! If the poet says of dust in the crack of a door, "Great Cæsar's ashes here!" and attach to the mote and the man common and equal significance, yet farther than this the naturalist; for him, not the greatest pile that ever rose over emperors' remains — not the pyramids,* tombs of Pharaohs, are so great, as this monument of life that Nature built — the simple sand. If ghosts be ever laid, here lie hosts, of creatures innumerable, vexing the mind in the attempt to conceive, never to compute, them; so minute that a grain of sand is prodigious beside. Creatures of wonderful, beautiful, varying shapes; creatures that ate and drank after their fashion and went on rejoicing or grieving till the day came. Let us write a name in the sand; the wave comes — the ebb, the cradle, — the flow, the grave — of such short-lived creatures; what to these then, that write their name in the "sands of time;" the coast of a continent their grave, the beach their monument, each sand-grain an epitaph.

How long this book has been making we do not know; no man's time will suffice him to turn and read even a single page. Reflection confounds; still we may stroll on, observant, if not thoughtful; a letter, a point, an intelligible note, may catch the eye; and trifles enough have at least some pith. Say, at the moment, there is no living thing in sight. As a wave curls away from the mirrored sand, little bubbles play here and there for a few moments, and then too subside. Under the sand, where each bubble rose, lives a creature,

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* And these too, are of a sort of limestone, called "nummulitic" because chiefly composed of vast numbers of certain Foraminifers (*Nummulites*). An ounce of Foraminiferous sand is estimated to contain upwards of four millions of these protozoans.

encased in shell armour, rarely seen alive, and scarcely known except by its casement, when this is thrown upon the beach; what some call a razor-shell, others *Solen ensis*. When the foot presses in yielding sand, surcharged with moisture, a slender jet of water spirts up; below is a clam (*Mya arenaria*): it dislikes the weight upon its elastic home, and remonstrates. There goes a groove in the sand, as if a child had wantonly dragged its copper-toed boot along, or some curious share had turned as curious a furrow; but the creature that made it has gone below, after what would have seemed to us, had we witnessed it, a tedious journey. Scattered here and there are large globular, yet essentially spiral, shells of the sea-snail (*Neverita heros*); the animal that lives in them made that mark, unfolding a great fleshy "foot," and gliding along, perhaps eating something as it went, with an organ that is mouth and limb in one. Where it is now, under the sand, are plenty more mail-clad things, of all shapes and sizes and colors; snug and secure, giving no sign of their presence. The sand is not only a great closet of foraminiferous skeletons; it is full of flesh and blood.

But we may look for signs from above as well as under the earth, or from the waters beneath; the sand tattles many pleasant, harmless secrets, if we only attend. Here are foot-notes again, this time of real steps from real feet; the next tide will wash them out; but perhaps some one of them, —the one chance of millions—may be left to signal, centuries hence, as much as they tell now. They are wedge-shaped, and meaningless as the cuneiform characters upon a Babylonic obelisk, unless the key to the cryptogram is found; for this, the lock must first be examined to the last detail, and it is surprising how many details there are. The imprints are in two parallel lines, an inch or so apart; each impression is two or three inches in advance of the next one behind; none of them are in *pairs*, but each one of one line is opposite the middle of the interval between two of the

other line; they are steps as regular as a man's, only so small. Each mark is fan-shaped; it consists of three little lines less than an inch long, spreading apart at one extremity, joined at the other; at the joined end, and *also* just in front of it, a flat depression of the sand is barely visible. So much: now following the track we see it run straight a yard or more, then twist into a confused ball, then shoot out straight; again then stop, with a pair of the foot-prints opposite each other, different from the other end of the track, that begun as two or three little indistinct pits or scratches, not forming perfect impressions of a foot; where the track twisted there are several little round holes in the sand. The whole track commenced and finished upon the open sand. The creature that made it could not, then, have come out of either the sand or the water; as there are no fire-animals now days, it must have come down from the air; a two-legged flying thing — a bird. To determine this, and next, what kind of bird it was, every one of the trivial points of the description just given must be taken into account.

It is a bit of autobiography; the story of an invitation to dine, acceptance, a repast, an alarm at the table, a hasty retreat. A bird came on wing, lowering till the tips of its toes just touched the sand, gliding half on wing, half a foot, until the impetus of flight was exhausted; then folding its wings, but not pausing, for already a quick eye spied something inviting; a hasty pecking and probing to this side and that, where we found the lines entangled; a short run on after more food; then a suspicious object attracted its attention; it stood stock-still (just where the marks were in a pair) till, thoroughly alarmed, it sprang on wing and was off. So much is perfectly plain and intelligible; it may be not quite so easy to find out what the bird was, for we will shut the "back-stairs" door and allow no guessing, but go honestly about our induction, as if we only knew of dead birds in the closet, and had never seen a live one.

Each foot-print was of three marks only; clearly then made by a three-toed bird; or, if by one with four toes, the fourth was too short to reach and impress the ground visibly, or else was joined to the leg too high up. The three marks all point forward; then the hind toe, or *hallux*, as it is called, was the missing or rudimentary one. Now, unless the bird was of a kind unknown to naturalists, which is highly improbable, it must have belonged to one or the other of two groups — the Walkers and Waders, or the Swimmers — named, respectively, *Cursores* and *Natatores*, since no bird of the only other remaining group (*Insessores*) has none, or a rudimentary hind toe.* Birds, however, cannot swim unless their feet are fashioned into paddles of some sort. We only know of this being done in two ways: either by stretching a membrane between the toes, making a webbed foot, or by fringing of the toes by broad membranes, making a lobed foot. But either of these feet, pressing the glassy sand, would have shown its pattern. Clearly then the bird was neither palmiped or lobiped — it was not one of the *Natatores;* it must have been a Wader. Other reasoning, from a different premise, brings us to the same conclusion. The marks were not in pairs, but alternating, each with its fellow of the other line; the bird did not hop or leap, but walked or ran bringing one leg after the other, whence we legitimately infer that it was not one of *Insessores* or Perchers; for these hop. But it might be asked, how do we know that the perchers hop instead of walking when on the ground, since we are agreed that we never yet saw a live one to find out by observation? Yet it is easy to reason up to such a point, that assumption is virtual certainty. For the hind toe (or each hind toe when there are two) of the *Insessores* is long, is inserted on a level with the anterior ones, and is armed with a curved claw as the others are. This arrangement is

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*To this and all other unqualified general statements in ornithology there are technical objections and real or apparent exceptions, not, however, invalidating general rules.

for the perfect opposition of the hind and front toes, as the thumb of our hand opposes the fingers; it infallibly suggests the idea of something to be clasped between—of grasping some object; the suggestion amounts to a moral certainty when we dissect and find among typical perchers a special muscle for the freer and more advantageous working of this hind toe in opposition to the others. Such birds then, live where their foothold is not upon a flat surface, as the ground, but upon slender, cylindrical, claspable supports, as are found in trees and bushes. But there cannot be much plain walking done among twigs; the birds must constantly spring from one to another branch, and when they happen to descend to the ground it is not likely they would at once change a habit inborn and inbred for ages. So with certain exceptions, not necessary to point out here, *Insessores* are hoppers, as distinctively as all birds below them are either Walkers or Swimmers.

This bird's wings never touched the sand, yet the marks show the shape of the wing as plainly as the character of the feet. The wings were flat, long, narrow and pointed, cutting the air like blades. We learn this from the few indistinct scratches on the sand just before the prints became perfect. The bird came gliding swiftly and low, and scraped the sand before its wings were closed; to do this requires a wing large or at least long. For all heavy bodied birds, or birds with wings small for their weight; or with short, rounded and concave wings—all these, however fast they may whirr along when fairly on wing, must drop quietly, if flying slowly, or arrest their motion abruptly and forcibly, if flying rapidly, to avoid shock on alighting; in either case they drop plump, and find their feet at once. Now of all our true walking or wading birds the *Gallinæ* (Grouse, Quail, etc.) and the *Paludicolæ* (Rails and Gallinules) conform to these last mentioned particulars; so does the Heron family, and these, moreover, have a long hind toe. It could have been neither of these. The circle of possibili-

ties is rapidly narrowing; we have only left whence to pick, the families of birds that make up the group *Limicolæ*, or the shore-waders, as distinguished from the *Paludicolæ*, or marsh-waders. Conning the *Limicolæ* over in mind, we fine there are but two families furnishing in our locality any species so small that the imprint of its toes is less than an inch long. These are the Plover and the Snipe families (*Charadriidæ* and *Scolopacidæ*).

We noticed just in front of the point where the lines of the three toes came together—at the "heel," as it is generally but wrongly called—that the depression of the heel-mark continued a slight distance between the bases of the toes. Clearly there must have been something of a web connecting the roots of the toes, just as our fingers are joined at the hand. Now our plovers and snipes each furnish us one, and only one, bird that is partially webbed and small enough to have made the tracks; these two are the Semipalmated or Ring Plover (*Ægialitis semipalmatus*) and the Semipalmated Sandpiper (*Ereunetes pusillus*); it might have been either, for anything we have yet noticed. Which was it? We have exhausted our foot-data, but still one mark is left, and that decides. The snipes have long bills, vascular, nervous, and sensitive at the tip; these are organs of touch; the birds *feel for* things they cannot see. The plovers have short bills, comparatively hard at the tip. There were little round holes in the sand, just where the lines tangled up; this was where the little bird stuck in its bill and probed for something. It would be useless for a plover to do this, for it could not *feel* anything if it did; we infer then, that a plover never would. And so at last, the bird stands confessed; Semipalmated Sandpiper, *Ereunetes pusillus*; section *Tringeæ*, of family *Scolopacidæ*, of group *Limicolæ*, of order *Grallæ*, of subclass *Cursores*, of class *Aves* or BIRDS.

REVIEWS.

SPONGES.* — Professor Hæckel in this paper has condensed the results of an extended and very remarkable series of investigations with regard to the affinities of the Sponges.

He places them nearest the corals, considering their canal system as homologous with the stomach and circulatory system of the corals. He farther identifies their structure by showing that in both of these types the primitive body wall consists of two layers, an outer homogeneous, which however, springs from an originally cellular layer, and an inner cellular membrane. This comparison is carried so far that as in the Cœlenterata (Acalephs and Polyps) the large vessel, which conveys away the water admitted through the sides by the smaller branches permeating the mass of the sponge, is called the stomach. Sponges are also stated to be either simple or compound, to be composed of one or more individuals in proportion as they have one or more afferent openings. Of course Professor Hæckel is well aware of the principal objections to his theory, and states them. The mouthless sponges, for instance, he accounts for by referring to the mouthless Sycocystis, which, however, has young with a well formed mouth. The fact, however, that the water permeating the sponge-body goes through minute apertures in the wall itself and is ejected at the so-called mouth, is not encountered with quite the same success. The cutaneous pores of the corals are supposed to be the same as these minute pores, and are supposed to perform the same or a similar office for the animal. The egg of the sponge (Prosycum) is said to pass through the mulberry condition, after which it becomes hollow and clothed with cilia. This cavity enlarging finally breaks through one end, and forms a mouth opposite to the end which has already become attached to the rocks. At this young stage it is said to be not essentially different from a fresh-water Polyp, or a young coral.

The author nowhere alludes to the late memoir of Prof. H. J. Clark, the most conclusive of any that has yet appeared, advocating the compound nature of the sponge. In this memoir it is clearly shown that in Leucosolenia, a marine sponge, the cells of the inner membrane lining the cavity (stomach of Hæckel) are monads and not true cells. That they have the single flagellum surrounded by a vail, or calyx, and contained contractile vesicles and particles of food in various states of digestion. Carter's observations, as well as Professor Hæckel's, distinctly confirm the flagellate, or single-haired, condition of the cells of the internal membrane, and the structureless, gelatinous nature of the external layer.

* On the Organization of Sponges and their relationship to the Corals. By Ernest Hæckel (Translated in the Ann. and Mag Nat. History Jan., 1870, from the Jenaische Zeitschrift B. v. p. 207).

Professor Clark found that the monads, hitherto considered one of the simplest forms of animal life, had a similar flagellum, but that this was used to procure food, which he distinctly saw as it entered the sac-like body through a mouth situated at its base. The lip of this mouth spread itself over the morsels which descended into a digestive vesicle in the inferior of the body. The series from this point to the sponge is completed by a form, Salpingœca, which with the same characteristics also secretes a gelatinous envelope. These anatomical facts fully justified the author of the memoir alluded to in claiming that he had discovered the true nature of the sponges, and they appear to indicate a much closer affinity between the sponges and the Uniflagellate Infusoria, and appear much more decisive than the coral-like characteristics described by Professor Hæckel.

The comparison of the aquiferous systems of sponges with the true stomach cavity and circulatory vessels of the coral is more than doubtful. The objection that the current flows in opposite directions cannot be met by comparing the perforations of the body wall in corals with those of sponges. It is well known that these perforations are common also in the star fishes and Polyzoa, and their precise import in either is as yet unknown. The most rational view would seem to be the opposite of Hæckel's, *i. e.*, that the pores are the mouths, and the so-called mouths the anal orifices, since out of these is all the refuse of the body thrown. Describing the radiating canals of Cyathiscus, the author asserts that the horizontal walls which divide these canals are absorbed, and the vertical walls are left standing, and thus a series of radiating chambers are produced, similar to those of the corals. Farther, that the only difference between them is that in corals the central stomach opens below into the common cavity, into which also the radial chambers open, and in Cyathiscus the stomach opens directly into the radial chambers by series of vertical pores, the former mouths of the lateral canals. This is perhaps the very strongest evidence brought forward by Professor Hæckel, and it is certainly a most interesting and remarkable fact, but seems hardly conclusive. The formation of the radiating partitions in the corals by the infolding of the inner membranes of the walls, is a very different process from that described above in Cyathiscus. How can we account for the fact that an individual with a large stomach cavity, and a set of circulatory vessels, has arisen when no useful end whatever could have been secured thereby? What useful end, or of what advantage is it to the species as an individual to possess numerous minute pores to admit food and rapidly enlarging canals, abutting finally in a large trunk to facilitate its emission. This is just the reverse of the economy of the organization of every individual, as such, in the animal kingdom. Individuals are universally possessed of facilities for obtaining and swallowing food in the shape of large pliable mouths and stomachs, whereas the emission of the refuse takes place through the smaller end of the canal or through the mouth again.

For the proper support of an individual it is evidently necessary that the food, whether microscopical in size or not, should be obstructed in its passage through the body and subjected to a thorough process of digestion. According to Professor Hæckel, however, we have in the sponge a creature in which all this is reversed, and a digestive system is presented to us which is perpetually increasing its facilities for getting rid of food as fast as it is swallowed. How this reversal of the animal economy can be of service to the race we cannot see, so long as we regard the sponge as an individual, or an aggregation of large individuals; but if on the other hand we adopt the opinion of his opponents, then all these difficulties disappear. We then see that the pores act as a strainer admitting only bodies of small size, such as are appropriate for the sustenance of the monads, which cover the internal surfaces of the canals. The gradual enlargement of these canals into a central trunk becomes at once appropriate, when we compare it with the similar facilities which are found in all compound communities for relieving the colony of refuse and deleterious matters. The fact noticed by the author, with marked emphasis, that each cell of his entoderm (internal membrane), is armed with a single flagellum is also explained, and the vase-like form of these cells noticed by Carter, and the amœba-like character of the external membrane, accords equally well with this view. We do not find in this article in fact any remarks which lead us to think that Professor Hæckel has paid such full attention to the structure of the single cells of his inner membrane as would justify him in adopting an opinion so entirely opposed to that which we have advocated. Of course in his forthcoming work this point may be more fully treated of; and since the whole discussion hangs upon a question of fact as regards the structure of the single cells of the internal membrane we may look for an early solution of this vexed question.

If we dropped the review here it would be treating Professor Hæckel with great injustice. Though forced to criticise the main point of his theoretical deductions, the studies upon which they are founded, like the other works of this eminent German zoologist, will be deeply felt in the history of the progress of knowledge in this department.

The account of the function and structure of the ectoderm, and of the development of the "ova" from special forms of his so-called cells of the internal membrane are of the greatest interest and importance. That, also, of the gradual development of the canal system gives us an entirely new and original view of sponge structure. In this connection the remarkable statements are made that species of Nardoa, Nardopsis and Cænostoma begin with a single stock which subsequently branches, only however to coalesce again as they approach maturity and unite their various apertures into one common trunk and single aperture; and also, that we can trace the origin of a species from the common stem form. To illustrate this last assertion the author instances two species, *Guancha blanca* and *Sycometra compressa*, whose variations are so great, and indi-

cate affinities, with so many different groups, that he has been obliged to place them in a separate order by themselves. "*Sycometra compressa appears as a sponge stock which bears upon one and the same cormus the mature forms even of eight different genera.*"

In conclusion Professor Hæckel begs all of his readers who may be in possession of specimens of calcareous sponges to send them to him for examination and comparison.

THE EXTINCT MAMMALIAN FAUNA OF DAKOTA AND NEBRASKA.* — This important work is the final expression, the author informs us, of labors extending over a period of twenty-three years, during which the materials on which it is based, have been accumulating. Sufficient time has elapsed to allow of corrections of first identifications, and we have the result in a memoir of much completeness and accuracy in the topographical descriptions of the remains preserved in such unusual perfection and abundance in the localities in question. Fortunately the Academy of Natural Sciences of Philadelphia numbers among its members liberal minded men of wealth, for without the "sinews" of the undertaking furnished by Messrs. Joseph Jeanes and William P. Willstach, this work would not have seen the light. As it is, the execution both in printing and lithography, is a credit to all concerned.

The species hitherto discovered in the Bad Lands belong to two series of strata, determined many years ago by Dr. F. V. Hayden to be Miocene and Pliocene respectively. Fossils from these, and a few of Postpliocene age are included, derived from the area in question. The whole number described is eighty-six, distributed as follows: Carnivora, fifteen; Artiodactyla, thirty-four; Perissodactyla, twenty-nine; Rodentia, six; Insectivora, two. With reference to the relations of the genera and species, we let the author speak, by quoting his valuable summary at the close of the descriptive portion of the work:

"In comparing the two lists representing the North American tertiary mammals, mainly from the states of Dakota and Nebraska, with the third list representing the quaternary mammals of the same continent, a remarkable dissimilarity is observed, and there is also noticed a greater resemblance of the former with the tertiary and quaternary mammals of the old world.

Of thirty-two genera of miocene terrestrial mammals, chiefly from the Mauvaises Terres of Dakota, not one occurs in the quaternary formation of North America; and of twenty-one genera of pliocene terrestrial mammals, chiefly from the Niobrara River of Nebraska, only eight are common to the quaternary formations of North America, and of these eight three are absent in the existing fauna of the continent. The eight genera alluded to as common to the pliocene tertiary and the quaternary formations are Canis, Cervus, Dicotyles, Mastodon, Elephas, Equus, Hipparion and Castor.

It is uncertain how far the species of Canis attributed to the Niobrara pliocene formation are peculiar to it. Part of the fossils may be quaternary, or perhaps, even recent remains. Of Cervus, part of the specimens referred to it may be of a recent species, while the antler viewed as pertaining to the same may represent a peculiar genus, subsequently extinguished. The only remains indicative of Dicotyles was an upper canine tooth which may really have belonged to a quaternary or perhaps a recent species. The remains of the pliocene mastodon

* The Extinct Mammalian Fauna of Dakota and Nebraska, with a Synopsis of the Mammalian Remains of North America. By Joseph Leidy, M. D., LL. D., preceded by an Introduction on the Geology of the Tertiaries of Dakota and Nebraska, by Professor F. V. Hayden, M. D.

pertain to the subgenus Tetralophodon, while those of the quaternary period belong to the subgenus Trilophodon.

The remains of Elephas probably indicate a species distinct from the quaternary *E. americanus*, though it is not positively ascertained. The remains of Equus appear to be different from those of the later *E. fraternus*. The genus Hipparion is clearly common to both the pliocene and quaternary period, but the species are different. Protohippus, one of the solipedal genera of the Niobrara pliocene, appears also to have existed during the quaternary period, in Chili, South America. A small species of Castor, of the Niobrara pliocene, is represented by the larger quaternary and still existing Beaver.

The quaternary fauna of both American continents was especially distinguished by the presence of those wonderful creatures, the giant sloths, no trace of which has been detected in the tertiary formations of North America. This appears the more remarkable from the circumstance that remains of several edentate genera have been discovered in the miocene formations of Europe.

The presence in the quaternary fauna of North America of the great sloths, together with other ordinal and generic forms, which likewise existed, and in part still continue to exist, in South America, leads to the impression that the North American continent during the quaternary period was peopled by the extension of life from the south. The greater similitude of the miocene and pliocene faunæ which we have investigated in the present work, with the contemporaneous faunæ of the old world, suggests the probability that the North American continent was peopled during the tertiary period from the west. Perhaps this latter extension occurred from a continent whose area now forms the bottom of the great Pacific Ocean, and whose tertiary fauna is now represented east and west by the fossil remains of America on the one hand, and of Asia with its peninsula, Europe, on the other.

In comparing the miocene and pliocene faunæ with each other, as represented mainly by the remains from the Mauvaises Terres and the Niobrara River, we observe the remarkable fact that in upwards of fifty genera belonging to the two faunæ together, scarcely a genus is common to both. In view of the consecutive order and close approximation in position of the two formations and faunæ, such an exclusiveness would hardly have been suspected.

Thus, for instance, the pliocene Merychyus may be regarded as identical generically, with the miocene Oreodon; but after all these are the only ones which could be looked upon as the same, unless perhaps Rhinoceros is included. In this case, however, the miocene *Rhinoceros occidentalis* appears to have been an Aceratherium, while that of the pliocene formation was probably a true or horned Rhinoceros.

Of all other known faunæ, extinct and recent, those of Dakota and Nebraska, under consideration, appear to approximate most in their relationship with the tertiary faunæ of Europe.

Of the carnivora of the former localities, comprising eight genera and fifteen species, five of the genera, or more than one-half, are found in the European tertiaries, as for instance: Canis, Amphicyon, Hyænodon, Pseudælurus, and Drepanodon. The feline Dinictis of the Dakota miocene has not elsewhere been discovered. The remaining two carnivorous genera are too imperfectly known for comparison.

It is truly wonderful that of the numerous Ruminantia, comprising fourteen genera and nearly double that number of species, none, excepting the genus Cervus, belongs to any other known fauna extinct or recent. Even in the case of the excepted genus, it is probable that part of the remains attributed to it may belong to a peculiar subgenus, while others may be of a recent species.

When we compare the family relationships of the North American tertiary and quaternary ruminants, we find remarkable differences. A peculiar family, the Oreodontidæ, is represented in both the miocene and pliocene: in the former by three genera and many species, in the latter by a single genus. This family has nowhere else been discovered, neither in the American quaternary nor the foreign tertiary equivalents.

Another family, the Agriochœridæ, nearly allied to the former, is peculiar to the miocene of the *Mauvaises Terres*.

The Camelidæ are represented in the North American miocene pliocene and quaternary deposits, but particularly in the miocene, and they are yet represented in the existing fauna of South America.

The Moschidæ are represented by the genus Leptomeryx in the Dakota miocene, but not in the later formations of North America.

The Cervidæ are represented in the pliocene and succeeding epochs in North America. The Antilopidæ are represented by a genus in the Niobrara pliocene. The Capridæ and Bovidæ are not represented in North America prior to the quaternary period.

Of Artiodactyla exclusive of the Ruminantia, the remains of seven species of six genera belong to the Dakota miocene, of which two genera, Elotherium and Hyopotamus are common to the European tertiary. The remaining genera in part but imperfectly known, appear to be peculiar. The Niobrara pliocene presents us with traces of a peccary, but this probably may belong to a later period.

One of the artiodactyle genera of the Dakota miocene, the huge Titanotherium, was represented by the nearly allied Chalicotherium of the European and Himmalaya miocene period.

Of uneven-toed Pachyderms or Perissodactyla, the Dakota miocene presents one Aceratherium, a peculiar genus of the same family, the Hyraeodon, and a species of Lophiodon. The former and latter are both European tertiary forms. Another member of the Rhinoceros family, *R. hesperius*, from California, was probably an Aceratherium of miocene age. *R. meridianus* of Texas was probably of the same category as the latter.

The Niobrara pliocene presents us with three genera, Rhinoceros, Mastodon and Elephant. The former has not been found in the American quaternary, though abundant in its European equivalent, and continuing to exist in Asia and Africa. The Mastodon belonged to the subgenus Tetralophodon, while that of the quaternary period was a Trilophodon. Elephants of other species were nearly cosmopolite during the quaternary period; but two species now live in Asia and Africa.

Five genera of Solipeds appear to have lived in North America during the miocene period. Three of them are peculiar, and appear not to have been discovered elsewhere. They have been named Anchippus from Texas, Hypohippus from the Niobrara River, and Anchippodus from New Jersey. The remaining genus Anchitherium, characterized by an abundance of remains from the Mauvaises Terres belongs also to the European miocene.

The pliocene formation of the Niobrara is remarkable for the abundance of its equine remains, which have been referred to five genera, of which Merychippus and Parahippus are peculiar, and Protohippus has been discovered elsewhere only in South America. The remaining genera Hipparion and Equus belong also to the North American quaternary and likewise to the European quaternary and tertiary formations.

The miocene Rodents of the Mauvaises Terres belong to four peculiar genera of as many still existing families. One of the genera, Palæocastor, may be identical with the European chalicomys of Cotemporaneous age.

The pliocene Rodents of the Niobrara appear to belong to the still existing genera Castor and Hystrix, but the latter now exists only in the old world.

Of the few discovered quaternary rodents of North America, one genus, *Hydrochœrus*, now absent on this continent, still lives in South America.

The miocene Insectivora of North America belong to three genera not discovered elsewhere." pp. 359–362.

In reviewing the character of the work, the care and accuracy of the descriptions furnish a most valuable storehouse to the palæontological student of other strata or localities, and its conscientiousness in this respect constitutes its great merit. On the other hand, however, we fail to find in many cases, that exact comparison and clear diagnosis of genera proposed or adopted, by which the zoological affinity is alone expressed, and by means of which the analysis of the subject in the broad sense is so greatly facilitated. Without it, the student gropes in a mass of detail, and unless he fortunately have access to a good museum, will fail of acquiring a mastery of it. This refers also to a precise comparison with European genera, for which we have so many standards in figures and descriptions.

The synopsis of extinct mammalia is of equal or greater value to the student. The whole number of species enumerated is two hundred and three, of which Dr. Leidy has stood sponsor to one hundred and twenty. The species are distributed into the orders as follows: Carnivora, thirty-three; Artiodactyla, fifty-two; Perissodactyla, thirty-seven; Rodentia, twenty; Insectivora, five; Marsupialia, one; Edentata, seven; Sirenia,

two; Zeuglodonta, two; Cetacea, forty-four. There are several species described for the first time, and the literary references are very complete. The system adopted by Dr. Leidy requires some comment. He adopts the order Bimana, a step which we regard as retrograde, since modern investigations, fresh in the mind of every student, have proved beyond cavil that that group is subordinate to the order Quadrumana. The division of Artiodactyla into Ruminantia and Artiodactyla as orders, ranking with other groups so-called, on the presence or absence of the functional peculiarity of rumination, is also contrary to the philosophy of a homological system. The separation of the Pinnipedia from the Carnivora has in the same manner little better foundation. The adoption of the Zeuglodonta as an order is perhaps a step forward, though in that case the Squalodons, which embrace ten of the twelve species included, must certainly be referred to the Cetacea. The separation of the Sirenia as an order has met with favor from Owen and others, and is well adopted in the present work.

THE EARLIEST EVIDENCES OF PLANT-LIFE.* — In this pamphlet Professor Dawson reviews the different substances which have been supposed to show that plants existed contemporaneously with the Eozöon in the Laurentian of Canada.

"We may sum up these facts and considerations in the following statements: — First, that somewhat obscure traces of organic structure can be detected in the Laurentian graphite; secondly, that the general arrangement and microscopic structure of the substance corresponds with that of the carbonaceous and bituminous matters in marine formations of more modern date; thirdly, that if the Laurentian graphite had been derived from vegetable matter, it has only undergone a metamorphosis similar in kind to that which organic matter in metamorphosed sediment of later age has experienced; fourthly that the association of the graphitic matter with organic limestone, beds of iron ore, and metallic sulphides greatly strengthens the probability of its vegetable origin; fifthly, that when we consider the immense thickness and extent of the Eozoonal and graphitic limestones and iron-ore deposits of the Laurentian, if we admit the organic origin of the limestone or graphite, we must be prepared to believe that the life of that early period, though it may have existed under low forms, was most copiously developed, and that it equalled, perhaps surpassed, in its results, in the way of geological accumulation that of any subsequent period."

FOSSIL BIRDS.† — In this little pamphlet Professor Marsh imposes a new obligation on the science of Paleontology, by the discovery of five species of Cretaceous birds. Among the species there is one, *Paleotringa vetus*, described from the original specimen found by Dr. Morton. This is the first fossil bird bone found in this country, and though referred to by Dr. Morton in his Organic Remains of the Cretaceous period, has been hitherto considered a recent specimen, which by some accident had been buried in the Cretaceous marl deposits. The forms embrace one large swimming bird (*Laornis Edwardsianus*), two gulls (*Palæotringa littoralis*

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* On the Graphite of the Laurentian of Canada. By J. W. Dawson, LL. D., etc. Proceedings of the Geological Society, Postponed Papers, Vol. xxvi, Part 1. Pamphlet, pp. 5.

† Notice of the Fossil Birds from the Cretaceous and Tertiary Formations of the United States. By Professor O. C. Marsh. From American Journal of Science and Arts, March, 1870. Pamphlet, pp. 16.

and *P. vetus*), and two rails (*Telmatornis priscus* and *T. affinis*). Besides these there are descriptions of four species of Tertiary birds, the first that have been regularly described from that formation in this country. These are said to be more closely allied to existing species than those of the Cretaceous. They are *Puffinis Conradi*, *Catarractes antiquus*, *Grus Haydeni*, and *Graculus Idahensis*.

Though the discovery of that remarkable bird, the Archæopteryx, in the Jurassic beds, led naturalists to suppose that Cretaceous forms would be eventually discovered, to Professor Marsh's energy we owe the fulfilment of these anticipations.

NATURAL HISTORY MISCELLANY.

BOTANY.

Hibernation of Duck-weed. — It has long been known that some species of *Lemna*, or duck-weed, produce, at the approach of winter, leaves of a different character to those formed in the spring, which fall to the bottom of the pond or stream, enabling the plant to live through the winter. A series of more accurate observations on this point is recorded by M. Van Hoven in the "Bulletin de la Société Royale de Botanique de Belgique." The species of *Lemna* indigenous to Belgium are the same as those found in this country; of these M. Van Hoven finds that two only, the *L. polyrrhiza* and *gibba*, produce leaves of a different form in winter; while with the three other species, *L. minor*, *trisulca*, and *arrhiza*, the ordinary leaves live through the winter, remaining on the surface. In *L. polyrrhiza* these winter-leaves first make their appearance in August or September. They are much smaller than the ordinary leaves, reniform or sometimes elliptical, olive-brown on both sides, and not gibbous beneath; their roots are exceedingly minute, and at first hidden within the leaf. The aëriferous cells which serve to support the ordinary leaves on the surface do not exist, causing the winter leaves to resemble an undeveloped bud. In consequence of the absence of these vessels they are heavier than the water, and fall to the bottom as soon as any agitation of the water detaches them from the parent leaf, which perishes with the first frost. At the ordinary period of the revival of vegetation, a small bubble of oxygen appears on the upper surface of these submerged leaves, which carries them to the surface, from which they again descend should the temperature fall below a certain point. In *Lemna gibba*, leaves of a similar character were observed hibernating beneath the water, differing in shape, size, and structure from those developed during the summer. — *Quarterly Journal of Science.*

The Fragaria Gillmani Again.—In simple justice to those concerned, I think it but right to state that specimens of this strawberry have lately been examined by Dr. Asa Gray, and that he confidently considers it *F. Mexicana* Schlechtendal. At the same time he admits that Schlechtendal in his description has omitted all mention of the well-developed leaf on the scape, which Dr. Gray allows, "proves to be, or to be connected with, the distinguishing character of the species," adding that "no one could tell from Schlechtendal's description whether or not he had a plant like this in view." It will thus be seen that he does not entertain the idea that it is merely "an accidental variation of *F. vesca*," as some would have made it, and that whether it is a new species or not, it is one not hitherto described, or at least not sufficiently so for identification.

In view of the interest at present manifested in England in regard to the *Everlasting Andine Strawberry*, and the discussion as to whether it would retain its perennially fruitful habit, I would state that the Mexican everbearing strawberry (*F. Gillmani* Clint.) has held this everbearing character for ten years in the State of Michigan. Plants removed to the house from the open ground last January are now (March 22d, 1870) in fruit. The plant has been raised from seed during the past season, and the seedlings continue to produce all the characteristics of the parent plants, with dichotomous stem and racemose flowers, even to the blossoming and fruiting of the stolons, and that when but four months old! — the leafy character of the stem being a marked feature. — Henry Gillman, *Detroit, Michigan.*

Vital Force and Color in Plants. — In my remarks on the yellow-flowered variety of the purple Sarracenia, in the March number of the Naturalist, the parenthesis, on page 44, contains an evident *lapsus pennæ*. Instead of reading "(white being taken as absence of color)," it might be corrected and improved so as to read as follows: — "(white being taken as accession of color and diminution of vital force.)" It has been repeatedly demonstrated that plants with variegated leaves, such as are so greatly sought after at present, are much more delicate than their plainer brethren, which, with less color, require less protection. This, I believe, is well understood by nurserymen who govern themselves accordingly. A multitude of facts are, day by day, grouping themselves about this interesting subject, and more clearly defining the laws which govern it. As we better understand the effects on vegetation of different mineral constituents of the soil, more light will be shed in this direction.

It has been remarked that when a flower is of two colors, they are almost always complements of each other. Familiar instances of this are the forget-me-not and the autumnal asters. More beautiful instances are the fairy bird's-eye primrose of the rocks (*Primula farinosa* Linn.), bearing pale lilac blossoms with yellow eyes, powdered with silvery farina, and the peerless calypso, nymph of the hemlock groves (*Calypso borealis* Salisb.), with brilliant purple petals, and lip maculated with a darker purple, almost hiding the flush of rare yellow glory within. Where there

are three colors, the third is commonly white, — the union of the other two, as it were. A fine illustration of this is seen in the showy moccason-flower (*Cypripedium spectabile* Swartz.). The snow-white petals spread above the inflated lip of as perfect a white melting into pink, which in turn, deepens into purple in front; while, drooping into the cavity, depends the singular petal-like sterile stamen of a pale lemon-color blotched with tawny spots. Another elegant example of this is presented by the *Calopogon pulchellus* R. Br., the club-shaped hairs in the beautiful beard of which are pure white, bright yellow, and rich purple. The white is distributed, if we may use the expression, into yellow and purple. — Henry Gillman, *Detroit, Michigan.*

The Lianis or Woody Climbers of the Isthmus, form, as is well known, entangled obstructions in the forests, which can be penetrated only by aid of the axe or *machete.* M. Lévy, a botanical traveller in Nicaragua, sends to the "Bulletin of the Botanical Society" of France (Nov., 1869) an interesting account of them. The stems send out aerial roots freely, many of which reach the ground, when they enlarge in diameter and form new trunk-like supports. When cut in two the lower end of the severed stem sends down a root to rëestablish its connection with the ground. M. Lévy, finding one in this condition from which hung roots a foot long, cut it off anew; two days afterwards it had produced new roots of the same length. Cutting it again it promptly made new roots, but more slender ones. He repeated the operation up to the eighth time, but the new roots were now so slender and feeble that he desisted. The plant was a species of *Bignonia.*

Japanese Sea-weeds. — At a recent meeting of the Royal Academy of Amsterdam, a collection was exhibited to illustrate the care taken by the Japanese in applying to beneficial purposes the natural products of their country. The collection consisted of sixteen species of algæ which are useful for food or other purposes, together with fabrics manufactured from some of them. Several of the species were altogether new; in other instances the application was entirely novel. — *Quarterly Journal of Science.*

ZOOLOGY.

A New Insecticide. — M. Cloez. who is engaged at the garden of the Paris Museum. has invented what he considers a complete annihilator for plant-lice and other small insects. This discovery is given in the "Revue Horticole," with the endorsement of its distinguished editor. E. M. Carrière. To reduce M. Cloez's preparation to our measures, it will be sufficiently accurate to say, take three and one-half ounces of quassia chips, and five drachms of stavesacre seeds. powdered. These are to be put in seven pints of water, and boiled until reduced to five pints. When the liquid is cooled, strain it, and use with a watering-pot or syringe, as may be most convenient. We are assured that this preparation has been

most efficacious in France, and it will be worth while for our gardeners to experiment with it. Quassia has long been used as an insect-destroyer. The stavesacre seeds are the seeds of a species of larkspur, or Delphinium, and used to be kept in the old drug stores. Years ago they were much used for an insect that found its home in the human head, but as that has fortunately gone out of fashion, it may be that the seeds are less obtainable than formerly. The stavesacre seeds contain Delphine, which is one of the most active poisons known, and we have no doubt that a very small share of it would prove fatal to insects. — *Scientific Opinion.*

Fauna of Round Island. — The remarkable discovery has been made by Sir H. Barkly, Governor of Mauritius, of four species of snakes and several species of lizards, in Round Island, a small island twenty-five miles from Port St. Louis, and separated by a sea only four hundred feet deep, no animals of that description being natives of the Mauritius. The flora was also found to be to a great extinct specifically distinct. — *The Academy.*

Position of the Brachiopoda in the Animal Kingdom. — For some time past the writer has had reasons for believing that the Brachiopods, with the Polyzoa, had greater affinities with the worms than with the mollusks. He has studied attentively *Terebratulina* and *Discina* as well as their early stages, and in all points of their structure interprets articulated characters, and not molluscan characters. Without entering into particulars at this time, he would state that in the structure of the shell he finds the greatest resemblance to the shell of crustacea, both as regards the peculiar tubular structure, and the scale-like appearance, and its chemical composition. In *Lingula*, while the carbonate of lime amounts to only six per cent., the phosphate of lime amounts to forty-two per cent.

The horny setæ which fringe the mantle are remarkably worm-like. In worms the bristles are enclosed in muscular sheaths, while in other articulate animals the hairs are simply tubular prolongations of the epidermal layer. In the Brachiopods these bristles are secreted by follicles and are surrounded by muscular fibres, and are freely moved by the animal. The structure of these setæ differ but little, if at all, from those of the worms.

The lophophore with the cirri is to be compared to similar parts in the tubicolous worms, and the mantle which covers and conceals their arms, is to be compared to the cephalic collar, as seen in Sabella, for instance, where we find it split laterally, and a portion reflected. If this were greatly developed so as to cover the expanded fronds of cirri, we should recognize quickly the relation between the two.

Dr. Gratiolet has compared the circulatory system of the Brachiopods to that of the crustacea, and Burmeister has shown a resemblance between the respiratory apparatus of certain cirripeds and that of Lingula.

In the reproductive system there is a close similarity existing between the oviducts of Brachiopoda, with their trumpet-shaped openings and, similar organs in the worms.

In the little knowledge we have of their embryology, the strongest proofs exist of their affinity with the worms. Lacaze-Duthiers figures the embryo of Thecidium, and it is a little animal with four segments. Fritz Müller figures an early stage of Discina, and we have recalled to us a positive articulate and worm-like character. From the body of this embryo, prominent bristles project. Smitt figures the same in the embryo of Lepralia, wherein he describes six bristles that appear locomotive; and Claparède figures the embryo of Nerine, a worm, in which we find similar bristles projecting from the body. In this connection it is interesting to note that in the winter eggs, or statoblasts, of Polyzoa we have a relation to similar characters among the lower crustacea, the ephippia of Daphnia, and the winter eggs of Rotifers, for example.

Leuckart places the Polyzoa with the worms, and the close affinity of the Polyzoa with the Brachiopoda is now freely admitted, and we now recall those peculiar worms, or early stages of them, which so strongly resemble in almost every essential point of their structure the hippocrepian Polyzoa.

As many of the foregoing points need ample illustration, and as the writer has in preparation a memoir on the subject, he will now only call attention to the facts supporting these views, evolved from the study of living Lingulæ. It is but justice to state that six months previous to the observations made on Lingula, he had come to conclusions herein expressed, and had freely argued it with his colaborators.

He saw the necessity of examining Lingula, however, before advancing these views, and for this sole purpose had visited North Carolina in company with Dr. A. S. Packard, jr., who with his observations on the worms and crustacea of that region yet found time to follow the writer, step by step, in his studies of Lingula, and was deeply impressed by the disclosures there made. His sincerest gratitude is due Dr. Elliott Coues, U. S. A., and Major Joseph Stewart, U. S. A., commandant at Fort Macon, North Carolina, for their constant aid and sympathy in furtherance of the object of his visit there.

After nearly a week's fruitless search, Lingulæ were found in a sand shoal, left at low tide. They were found buried in the sand. The peduncle, which was about six times the length of the shell, being encased in a *sand tube* differing in no respect from the sand tubes of neighboring annelids. In many instances the peduncle was broken in sifting them from the sand, yet the wound was quickly healed and a new sand-tube promptly formed. When placed on the surface of the sand they were noticed to move quite freely, by the sliding motion, in all directions, of the dorsal and ventral plates, aided at the same time by the rows of setæ or bristles, which swung back and forth like a galley of oars, leaving a peculiar track in the sand.

The peduncle was hollow, and the blood could be seen coursing back and forth in its channel. It was distinctly and regularly ringed, and presented a remarkably worm-like appearance. It had layers of circular and longitudinal muscular fibre, and coiled itself in numerous folds

or unwound at full length. It was contractile, also, and quickly jerked the body beneath the sand when alarmed.

But the most startling discovery in connection with this interesting animal was the fact, that its blood was *red*. This was strongly marked in the gills, which were found in the shape of a series of rows of simple lamellæ, hanging from the internal surface of the mouth; thus proving the correctness of Vogt's observations from alcoholic specimens. At times the peduncle would become conjested, and a deep rose blush was markedly distinct. The sexes were distinct.

The writer believes the Brachiopods to be true articulates, having certain affinities with the crustacea, but properly belonging to the worms, coming nearest the tubicolous annelids. They may better be regarded as forming a comprehensive type, with general articulate features. Possibly they have affinities with the mollusks, through the homologies pointed out by Allman as existing between the Polyzoa and Tunicates.

It is interesting to remember that Lingula, though one of the earliest animals created, has yet remained essentially the same through all geological ages to the present time. — EDWARD S. MORSE.

Fig. 76. Fig. 77. Fig. 78.

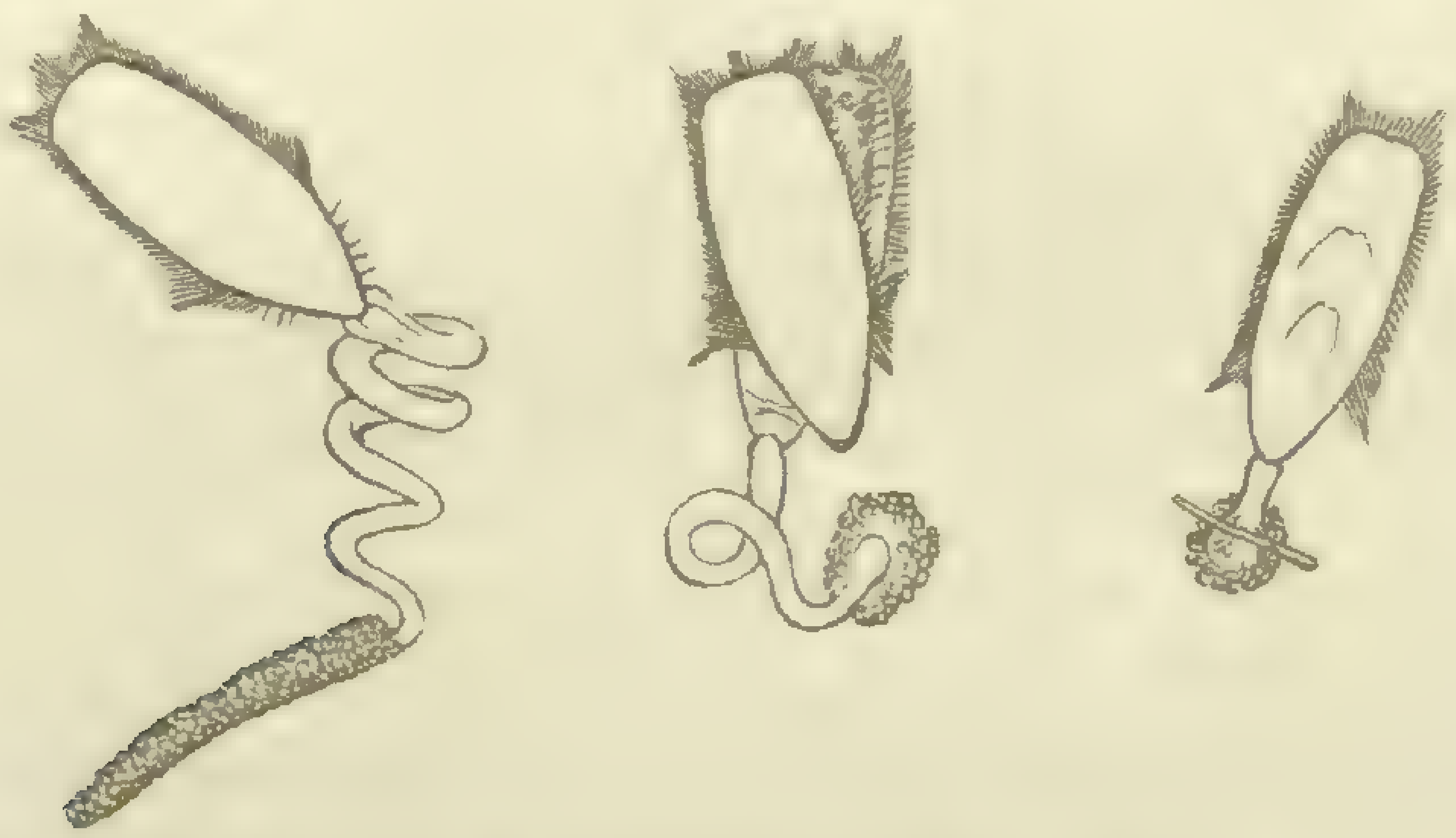

Fig. 76. Peduncle perfect, retaining a portion of the sand tube.
Fig. 77. Showing the valves in motion; the peduncle broken and new sand case being formed.
Fig. 78. Peduncle broken close to body and sand case being formed.

THE RUBY CROWNED WREN. — In reply to Mr. Allen's question, I may state positively that, according to my experience, the adult fertile female is "ruby-crowned" like the male. She is perhaps a trifle smaller, not quite so brightly colored, and with the flame-colored patch possibly of a little less extent; but she cannot be distinguished from the male with certainty, except on dissection, and even then it is not always easy to determine from slight inspection, unless the organs are enlarged in functional activity. The barren or sickly female may possibly not acquire the ornament. Birds of both sexes lack it for at least a year; whether they breed or not with plain heads I do not know. These come along in spring in the rear of the mature birds; they are most abundant at the time when the latter are about leaving. — ELLIOTT COUES.

GEOLOGY.

Geological Survey of Iowa. — The legislature of this state has discontinued the survey which was being so ably conducted by Dr. C. A. White. This seems inexplicable in a state which must necessarily be very largely benefited by the exploration and discovery of its natural resources. Legislatures, however, are not governed by the same rational laws of self interest which actuate private corporations and individuals. Though single mining and manufacturing companies consider it necessary to employ an engineer or a chemist, the legislatures are far too poor or too anxious about the next election to pay any attention to the development of the natural resources and mining interest of the state. Provision has been made, however, for the publication of the State Geologist's Report, which is to be completed in the same style as the Illinois Geological Survey.

New Fossil Turkey. — At the meeting of the Philadelphia Academy of Natural Sciences, March 8th, Professor O. C. Marsh of Yale College, exhibited a number of fossil remains from the Post-tertiary deposits of Monmouth county, New Jersey, which indicate a new and distinct type of birds, closely related, apparently, to the turkey, and not unlikely the progenitors of the existing species. The specimens shown were portions of three skeletons, of different ages, which belonged to birds about the size of the common wild turkey (*Meleagris gallopavo* Linn.), although proportionally much taller. The tibiæ and tarso-metatarsal bones were, in fact, so elongated, as to resemble those of wading birds. These interesting remains were referred provisionally by Professor Marsh to the genus *Meleagris*, and the species they represent was named *Meleagris altus*.

MICROSCOPY.

Circulation of the Latex in the Laticiferous Vessels. — Within a few days I have repeated some experiments (first made more than fifteen years since) upon the circulation of the latex in the laticiferous vessels of the leaf of *Chelidonium majus*, to which I desire to call attention.

Before detailing these experiments it ought, perhaps, to be stated that Amici, Dutrochet and Mohl deny any visible motion in them except such as is the result of injury; while Schleiden says "that in the uninjured vessels, the motion of the latex can very seldom be successfully shown;" even in *Chelidonium majus* it is only occasionally possible, and then presents great optical difficulties.

Now, I find, by potting a young plant of this kind, and placing any young leaf between two strips of glass (upon which a drop of glycerine has been put) in such a manner as to bring the under side of the leaf up-

permost on the stage of the microscope, so as to throw the strong reflected sunlight upon it from the mirror below, that;

First, there is occasionally either a nearly total want of motion or only a very slow one of the colored granules, or at times a very rapid motion of the particles to be seen, running from right to left, if the vessel happens to run horizontally on the stage, or toward me if the vessel runs from the outer to the inner border of the stage, and

Secondly, that while *watching* the circulation as seen through the lenses in the reflected sunlight, if I move the diaphragm from left to right, so as to make the shadow enter upon the right of the field of view, a brisk circulation (no matter how quiet it had been before) is instantly witnessed, which appears to be changed in direction as we move the diaphragm back again; and that the direction of the *circulation* can thus be *changed* at *will* by the *interception of the sunlight.* This same result can also be witnessed by the passage of clouds between the sun and mirror. The actual direction in the plant is *from* the apex of the leaf *in sunlight* and *toward* it in the shade. This *change in direction* is *so rapid* when produced by the *shadow* of *fast flitting* clouds across the sun's disc that it would seem that the change of temperature could hardly be felt by the plant, it certainly could not be by an ordinary thermometer; but a heated body properly placed will quicken the circulation, as will cold retard it. If I mistake not we have here a fine demonstration of the conversion of light into heat by its passage through the vegetable tissues, and of heat into motion by its action upon the laticiferous vessels.

Prof. Balfour in the Article Botany, "Ency. Brit.," says that in plants with milky and colored juices evident movements have been perceived, and mentions the calyx leaves of *Chelidonium majus*, as also the India-rubber plant, the gutta-percha tree, the dandelion, and the *Euphorbia*; and through your journal, should you think this article worth insertion, I would ask assistance in the examination of this interesting subject. By mixing a little of the colored juice with alcohol, and adding a little water, it will be seen that the motion of the liquids in the vessels cannot be the result of evaporation. And that it is not an ocular illusion may be argued from the fact that three independent observers witnessed the changes of motion as above described. — H. C. Perkins, M. D., *Newburyport.*

Note, May 12. I have just examined the circulation of the latex in the laticiferous vessels of *Leontodon taraxacum* under the same circumstances as that of *Chelidonium* and am pleased to find precisely the same results. — H. C. P.

Does Boiling destroy Germs? — This question cropped up in the course of the Pasteur and Pouchet controversy on Heterogeny, and it appeared that there are some germs that are not destroyed by boiling, but which require a temperature some degrees (10° or 12°, we believe) above boiling. This is another simple problem for microscopists. — *Monthly Microscopical Journal.*

ANTHROPOLOGY.

ARCHÆOLOGICAL IMPOSTURES.—To *hoax* is eminently an American proclivity or habit, a kind of friskiness not without a tinge of mischief, and always reckless, which pervades our society far and wide, and which is gratified by creating what is called "a sensation." Sometimes there is a sinister or selfish motive behind, and a deliberate imposture is practiced with the view to pecuniary advantage. Of this the "Aztec children" and the "Onondaga giant" are clear examples. The latter fraud, it is to be hoped, is defunct; the former flourished for years after it had been thoroughly exposed.

I have hunted down a score or more of these frauds on popular credulity, only to find a dozen others springing up in the place of each one slaughtered. Skeletons of giants resolving themselves into bones of the mastodon; great jawbones fitting over the faces of common mortals—just as though two spoons of equal size could not fit into or over each other—inscribed plates, such as of mica discolored by infiltrations of iron, etc., etc., *ad nauseam*. Not long ago I received a letter from a *savant* in Vienna, regretting that I had not given "a full and particular account" of the extraordinary vault, with its statues and inscriptions that had been discovered in the rocks of the Palisades of the Hudson, and hoping that I would prevail upon some competent western correspondent to make a farther careful examination of the recently discovered ancient tunnel under the Mississippi River, opposite St. Louis! During the last summer I received a note from a gentleman, whose name is not unknown as a north-western explorer, enclosing a slip from a Kansas paper, giving an account of the discoveries of "Professor Henry L. Scott, LL. D., of Georgetown, Ky.," near Evanstown, Shelby Co., Utah, in one of the cañons of Rear River in the Uintah Mountains. I quote from the article:

"Having secured the help of some half dozen men, Professor Scott immediately directed his course towards the South, where a bastard canon starts out from one of the Uintah spurs. Fortunately he had with him a half-breed who could converse with the Shoshones, who range all through that section, and through the interpretor he learned from Wa-pa-on-ta (Stag), a sub-chief of the Shoshones, that about fifteen miles from Evanston was a mound of extraordinary dimensions. The Professor immediately repaired to the place, and to his great gratification discovered a tumulus of as fair and positive proportions as any described by Squier and Davis. He immediately commenced the work of excavation, and in three days had the inexpressible pleasure of laying bare what was certainly a vault. He found a cavity about eight feet long, three wide, and four deep. Its bottom, sides and ends were made of triangular shaped stones, evidently quarried from the red granite of the Wasatch range. There was no top or covering to the vault, but from the nature and color of the earth immediately over it, the Professor thinks that an arch of burned clay had been used. But one skeleton was found, which on exposure, immediately crumbled into dust; it appeared to indicate that of a man not over five feet ten inches. The bones lay east and west—the skull east. At the foot, and apparently between the feet, was found an ordinary-shaped earthen pot, with a capacity perhaps of half a gallon, cone-shaped, and without any mark or engraving whatever on it. Along the left side lay an iron bracelet with a spring clasp, perfectly preserved. On each side of the skull were two medicine stones, shaped like a cigar, full of holes, and of half-pound weight.

The stones were very similar to Tennessee marble or Scotch granite. On the right side of the skeleton the Professor found a silver plate about the size and exactly the shape of an artist's palette. No mark whatever was distinguishable on this piece, but it is of the purest silver. It may have been used as a shield, though the Professor inclines to the belief that it was a "charm," and that the skeleton was that of some medicine man or priest."

I replied to my correspondent that I thought the whole story a "hoax," but if it would please him would soon find out if it were or not. I accordingly addressed a letter to the editor of the paper in which the article originally appeared, asking him on what authority the publication was made. He answered that it had been written by a sub-editor (giving his name) who, however, had left his employ, but to whom he would forward my letter. A few days ago I secured a note from the sub-editor aforesaid, in which he says:

"To be frank with you, 'Explorations in Utah' was a *sensation*, written to offset the forthcoming report of 'Professor Powell in the Colorado Canons,' and Colonel Samuel Adams' in Colorado,' both of which have since appeared. From personal observation in the region mentioned, I know both reports to be very erroneous."

I should perhaps mention that "Professor Scott's" explorations were alleged to have been undertaken under the belief that the race of the mound builders of the Mississippi Valley had migrated to Mexico and Central Mexico, and that traces of their transit might be found on the way. — E. G. SQUIER.

ANSWERS TO CORRESPONDENTS.

T. DUPUY, M. D. — Your specimens though inconveniently small for determination, are: 1, *Polypodium incanum*; 2, *Aspidium patens*; 3, *Parmelia pertata* variety *olivetorum*; 4, *Ramilina fraxinea*; 5, *Parmelia speciosa* variety *gramelifera*. Southern species of lichens and ferns are very acceptable. Send along some more. Your remarks upon the *Tillandsia usneoides* are interesting; may we hear more from you on the habits of the plants of your vicinity? — J. L. R.

BOOKS RECEIVED.

Annual Meteorological Synopsis. By J. B. Trembley, M.D., Toledo, Ohio. Pamph. 1870.

The One Hundred Dollar Prize Essay on the Cultivation of the Potato. By D. H. Compton. 8vo. pamph. Illustrated. Orange Judd & Co. New York, 1870. (25 cts).

The Geological Survey of Ohio, its Progress in 1869. Report of an Address delivered to the Legislature of Ohio, February 7, 1870. By J. S. Newberry, Chief Geologist. 8vo. pamph. 1870.

Narrative of a Bear Hunt in the Adirondacks. Read before the Albany Institute, January 18, 1870. By Verplanck Colvin. 8vo. pamph. J. Munsell. Albany, 1870.

Proceedings Academy of Natural Sciences of Philadelphia. No. 4. December, 1869.

Discourse on the Life and Character of George Peabody. By S. T. Wallis. Peabody Institute of Baltimore. 8vo. pamph. 1870.

Journal of the Quekett Microscopical Club. No. 10. April, 1870. 8vo. Plates. London. R. Hardwicke, for the Club. (1s. a number.)

Alaska and its Resources. By W. H. Dall. Large 8vo. Cloth. 628 pages. Many Illustrations and Map. Boston, 1870. Lee & Shepard. $7.50.

First Annual Report of the Geological Survey of Indiana, made during the year 1869. By E. T. Cox, State Geologist, assisted by Messrs. Bradley, Haymond and Levette. 8vo, cloth. pp. 240. 4 maps. Indianapolis, 1869.

On Existing Remains of the Gare-Fowl (*Alca impennis*). By Alfred Newton. [From "The Ibis" for April, 1870.]

Contributions to the Theory of Natural Selection. A Series of Essays. By Alfred Russel Wallace. pp. 384. 12mo. cloth. London and New York. 1870. Macmillan & Co.

The Naturalist's Guide in Collecting and Preserving Objects of Natural History, with a Complete Catalogue of the Birds of Eastern Massachusetts. By C. J. Maynard. Illustrated. pp. 170. 12mo, cloth. Boston, 1870. Fields, Osgood & Co. [$2.00.]

Annals of the Lyceum of Natural History of New York. Vol. ix. No. 10. April, 1870.

Naturalist's Note Book. April and May, 1870. London.

Universal Decimal Weight, Measure and Coinage Association. Circular No. 1. May, 1870.

On the Pre-Carboniferous Floras of North-eastern America, with special reference to that of the Erian (Devonian) Period. Abstract of the Bakerian Lecture. By J. W. Dawson. [From Proceedings Royal Society. London, 1870.]

THE

AMERICAN NATURALIST.

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THE LYRE BIRD.

BY GRACE ANNA LEWIS.

THE Lyre Bird finds in the south-eastern portion of Aus-

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tralia a region peculiarly adapted to its nature. At a variable distance from the sea rises a range of mountains, the swell of which is undulating rather than precipitous, while the summits expand into immense open downs and grassy plains. These are studded with belts and forests of trees, and appear like a succession of vast parks. As the hills and plateaus sink into the cup-like depression of the interior, marshy grounds alternate with parched and sterile barrens; but seaward, the soil is of almost inconceivable richness. Here, a tropical luxuriance prevails. Forests of immense, ever verdant, blooming trees, are broken by rich meadow-like districts admirably suited to grazing purposes. Indeed, the country as described, is so charming, that it might be considered almost a Paradise were it not for the intense heat of summer, increased, as it is, by the hot dry winds which blow southward from more northerly regions. Parching droughts are succeeded by torrents of rain, which, collecting on the hills and plains, and advancing through their streamlets, pour in swollen floods down the mountain sides to the sea, carrying destruction on every hand. Thus are the seaward slopes washed into gullies and ravines, which are left obstructed by fallen trees and branches. Over these active nature soon spreads a mantle of greenness and bloom, by means of rapidly growing creeping vines, forming almost inaccessible fastnesses. In these secluded haunts the Lyre Bird hides itself from the gaze of man. It is found over a large extent of country, but is peculiar to the mountain districts of Australia, and especially to those on the south-eastern face of the continent. Two species are known; one, *Menura superba*, the well-known Lyre Bird, the other a closely allied species, *Menura Albertii*.

Australia is a country of wonders, where even the leaves of the trees are so disposed that they present but little surface to the scorching sun, and, consequently, are almost valueless for shade; and where, both in the vegetable and animal world, are curious forms existing nowhere else on the globe.

Here is a rich display of birds with gorgeous plumage, and here also are found many remarkable only for their unlikeness to all others. Among the latter is a family, the members of which, with their peculiarly large feet, scratch up grass, herbage, and soil, and throwing these backward, in concentric circles, finally raise a mound which forms a veritable hot-bed. In this they deposit their eggs, and the heat engendered by the decaying vegetable matter quickens the life-germ, as in ordinary hatching does the warm body of the brooding mother.

What is especially curious is that the Lyre Bird, while incubating its eggs in the method common to birds, has a similar habit of raising mounds which it devotes to a wholly different purpose. These elevations seem to be intended as orchestras for the display of musical powers, and both morning and evening they betake themselves thither, frequently while they whistle, sing, or imitate the notes of other birds, raising and spreading their tails with all the pride of the peacock. M. Isidore Geoffroy Saint-Hilaire, refers both the Lyre Birds and the "Mound Builders" to one family, that of the *Megapodidæ*, or the Great Feet. It is by no means wonderful that this thought should have suggested itself to the mind of the learned naturalist, for there certainly is, in several respects, a striking similarity between the Lyre Bird and the Megapodes, a resemblance so strong as to be perceived even by the casual observer. But this similarity seems capable of explanation on other grounds than those of a family relationship, nor need we even suppose that the birds in question belong to the same order.

The Lyre Bird has been known for more than half a century, but possibly, our fullest information is derived from the English naturalist, Gould, who, with his wife, travelled in Australia for the purpose of ornithological investigation more than twenty years ago, and who since has, from time to time by his correspondence, obtained facts of much importance to ornithological science. To his pen, and to her

almost magic pencil, we are largely indebted for our knowledge of Australian birds. The pictures of both artists are so life-like that we might well be pardoned for forgetting that we had never heard the music of their songsters, nor beheld the flowering vine where it grew.

The whole collection of birds, forming the originals of Gould's "Birds of Australia," was purchased by Dr. Thomas B. Wilson and presented to the Academy of Natural Sciences in Philadelphia,—a gift to a noble institution of his native city, in which America has reason to rejoice. In this collection, along with other specimens of the Lyre Bird, may be seen that which furnished the half size illustration of Gould. It is somewhat faded by time, but otherwise is in a good state of preservation. From this bird our artist has given the cut heading the present article.

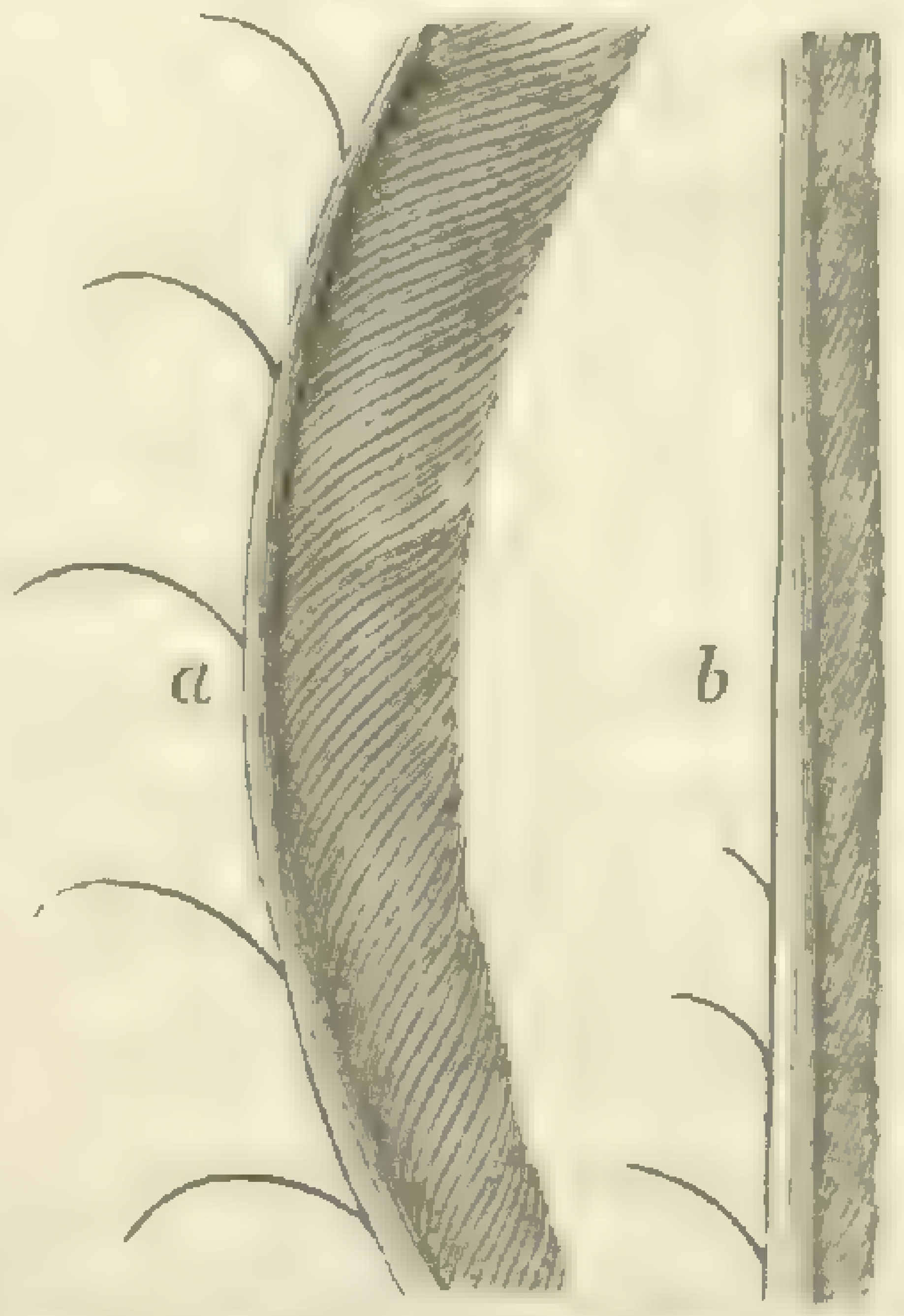
The bird is about the size of the common fowl. Its general plumage is of a dull leaden, or chocolate brown color, brightened on the wings, chin and front part of the throat with a reddish tinge, which is much richer during the mating season. The peculiar beauty of the bird, however, lies in its tail, which is in perfection only four or five months of the year. This appendage consists of sixteen feathers, twelve of which, as seen in the engraving, are furnished with loose, slender and flowing barbs, which are so distant from each other that their effect is that of a background of light and elegant tracery. Figure 80 shows a section from one of these feathers, the barbs, many of which are seven inches in length, having been cut away on either side of the central stem. Four of these feathers are of a closer texture near the base where firmness is required. The two unpliant middle feathers are,

Fig. 80.

Section from loosely barbed Feather, natural size.

on the outside, destitute of barbs, except a slight fringe near the termination. On the inner side there is a narrow vane gently expanding to a little more than half an inch at the widest part, but contracting towards the end. These feathers bend on either side over the delicate tracery, heightening its effect by their decided lines, as best seen in fig. 79. Figure 81 presents two sections, *a* from the terminal curve, and *b* from the middle of one of these rigid feathers.

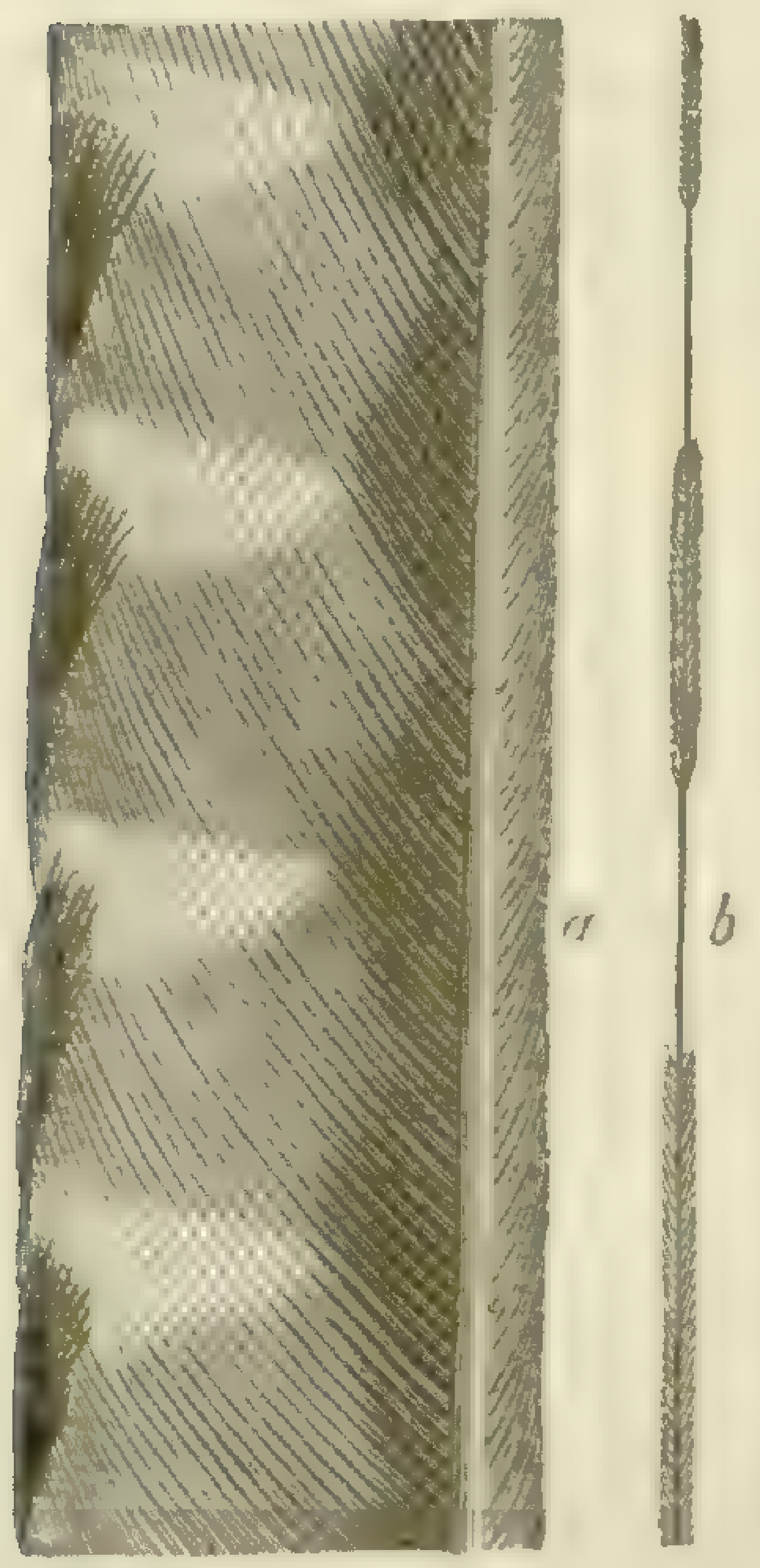
Fig. 81.



Two sections, natural size, *a* from terminal curve; *b* from middle portion of one of the central, rigid feathers.

But that which gives character to the whole is the arrangement of the external feathers. These curve in such a manner that the two together form the outline of an ancient lyre, an appearance so striking as to confer on the birds their popular name. These two feathers contrast with the middle ones by presenting vanes, *wide* on the inner side, on the whole length of the shaft. These vanes, are apparently frilled, but this singular effect exhibited at *a* in figure 82, which is a section, half size, from one of the exterior feathers, is produced by an alternate omission of barbules on the barb, as seen at *b*, fig. 82, which is a single barb. As the barbs are seen edgewise, they present, in the naked spaces, the appearance of transparency, and are usually so described. The microscope, however, proves that in these portions the barbs are not devoid of color. These two outer feathers are of one or more shades of brown and ash color, lighter than the general

Fig. 82.



a, Section, half-size, from one of the external feathers; *b*, single barb.

plumage, and are tipped with black. In running the tail is lowered and held horizontally, and when of full size it is nearly two feet in length.

Gould describes the Lyre Bird (*Menura superba*) as solitary, never more than one pair, and frequently only one bird being found in the same covert. It is extremely shy, and of all birds is the most difficult to capture, this being ascribed in part to its extraordinary powers of running and in part to the nature of the ground it inhabits, traversed as that is by immense, obstructed gullies and ravines. It seldom or never attempts to escape by flight, but like the Texan Guan, belonging to the Penelopidæ, frequently ascends trees to a considerable height, by leaping from branch to branch.

One mode of procuring specimens is by wearing the tail of a full plumaged male in the hat. The poor bird is deceived, and, approaching to greet a companion, easily falls a victim to the gunner. Any unusual sound, such as a shrill whistle, generally induces it to show itself for an instant; if this favorable moment is not seized instantly, the next it may be half way down a gully. None are so successful in the capture of these birds as are the native blacks of Australia. Restless and active, the *Menura* is constantly engaged in traversing the brush from one end to the other, and the mountain sides from the top to the bottom of the gullies, whose steep and rugged acclivities present no obstacle to its long legs and powerful and muscular thighs. It is also said to be capable of performing the most extraordinary leaps, frequently using this method of escape from its enemies.

Independently of its loud, full call, which can be heard reverberating over the gullies at least a quarter of a mile, it possesses an "inward and varied song, the lower notes of which can only be heard when the listener is within a few feet of the singer." This animated strain frequently ceases suddenly and then recommences with a low snapping sound, ending in an imitation of another Australian singer, the

Satin Bird, and is always accompanied with a tremulous motion of the tail.

Through a letter written from Sydney, Australia, by Dr. George Bennett, and published in the "Proceedings of the Zoological Society," London, we learn something of the Lyre Bird in a state of captivity.

The bird, described in the letter of Dr. Bennett, had been captured when so young that it was only just able to feed itself. It was in the possession of a gentleman who, when he first obtained it, fed it with great care and regularity on worms, grubs, German paste and beef chopped very fine, but as it grew older he added hemp seed, bread, etc.; in short, treating it as he would any member of the Thrush family. Of many specimens, of all ages, which he purchased as companions, this was the only one which survived, the others, brought from the Illawara district, lived but a short time. Apparently healthy and well when they whistled at dusk in the evening, the morning would present only a lifeless form. Others kept in an aviary in Sydney, survived their captivity but six months.

On the fourth of January, no indication of sex could be ascertained from the plumage of the individual described. Twenty days afterwards, when the bird was two years and four months old, two of the peculiar feathers of the male were developing.

This bird was in a constant state of restless activity, running rapidly about the spacious aviary in which it was confined, and leaping upon and over the stones and branches placed in the enclosure, yet with all its restlessness it would follow the call of its owner and take food from the hands of those to whom it was accustomed. It mocked with great accuracy the Piping Crow, Wonga Pigeon, Parrots and various other birds in the same aviary and in the vicinity, and about dusk in the evening was often heard to utter its own peculiar whistle.

Even in Australia this bird was so highly prized that a

liberal offer could not induce the possessor to part with it to send to England.

Another letter from Melbourne, Australia, written to Gould, informs us that the nestling bird is extraordinarily helpless; when taken forcibly from the nest, it walked most awkwardly, with its legs bent inwards, frequently falling, apparently from want of strength to move the large and heavy bones of its legs properly, and this at a time when its height was sixteen inches, and when its wings and tail were already furnished with feathers, although the body was still clothed with down, which, as well as the feathers, was of a dark brown color. When taken from the nest, the bird screamed loudly, and the mother, notwithstanding the proverbial shyness of the species, actuated by her maternal fondness, tried in various ways to deliver the captive. A shot was the reward of her devotion, and with its mother near it, the young *Menura* soon became silent and quiet. Afterward its cries for its natural protector being answered by an imitation of the mother's voice, it was easily led by the sound and soon became very tame. It was exceedingly voracious, but ate wholly in the manner of the Passeres, the nestlings of which hold the open beak in a vertical position, requiring food to be dropped therein. It was sustained principally by worms and the larvæ of ants, and when occasionally it picked up the latter for itself it never was able to swallow them, the muscles of the neck not having gained sufficient power to effect the required jerk and throwing back of the head. Remaining for an unusually long time in the nest, the young *Menura*, like the passerine birds in general, possesses the instinct of cleanliness.

The habits of *Menura Albertii* are very similar to those of its better known relative; the former, like the latter, being famous for its most extraordinary mocking capabilities. Commencing his song before the dawn of day, in fact being the earliest of song-birds, he continues till about an hour after sunrise, besides his own peculiar note imitating the

cries of all the birds in the bush. He then becomes silent and remains so during the day until about an hour before sunset, when he again commences singing and playing about until it is quite dark.

This species chooses sandy localities and feeds wholly on insects, mingled with a considerable proportion of sand, but is without the *crop* found among the gravel-using Rasores.

It commences building in May, lays its eggs in June, and hatches its young in July. Choosing some bare rock where there is a sufficient shelter for a lodgement, it builds an oven-shaped nest, outwardly constructed of sticks or roots, tendrils, or the leaves of palms, and lined with soft green mosses, or the skeleton leaf of the parasitical tree ferns,—a substance almost as elastic as horse hair. This nest is completely rain proof and has the entrance on one side.

A nest of this species, with two eggs, is deposited in the British Museum. The nest is about two feet in length, by sixteen inches in breadth, and is domed over except at one end. The eggs, about the size of those of the common fowl, are of a deep purplish chocolate, irregularly blotched and freckled with a darker color.

The nestling is covered with *white* down and remains six weeks in the nest.

In this species the male bird is about four years old before he acquires his full tail; the two centre curved feathers are the last to make their appearance.

Of the nest of *M. superba* we find no equally clear description, but it appears very nearly to resemble that of *M. Albertii*. The eggs of the former species are said to be of a lighter color, and the young to be blind as well as helpless.

The method of nest building, the helplessness of the young, and their passerine manner of feeding, taken in connection with the structure of the *Menuridæ*, all point to a position considerably higher than the Megapodes. It is true, the young are covered with down, but exceptions occur among the *Fissirostral* birds, as for instance, the Night Hawk

and the Whip-poor-will of the *Caprimulgidæ*, both of which are downy at birth; and the *Menuridæ* may present a similar exception in the group of the *Passeres*, where the young are nearly if not entirely nude.

Gray placed *Menura* among the Wrens. Jerdon assigned it a position intermediate between the Walking Birds,—including the common fowl and the Pigeons and Doves,—and the higher Land Birds.

Most ornithologists of the present day unite in considering it as a member of the *Passeres*, that group which includes our Thrushes, Wrens, Pewees, Humming Birds, Sparrows, Crows and all the multitude of their kind.

Professor Huxley has examined a portion of its anatomy with care, and while referring *Menura* to a group equivalent to the *Passeres*, sees so many distinctions between this and all other passerine genera, that he places it in a section of this group alone, no other birds in the world answering to the Lyre Birds.

Nitzsch, who with equal care, examined *Menura* in reference to plumage, reaches the same conclusion, that it is undoubtedly a passerine genus, but that in certain respects it differs from every other, while manifesting a relationship to the Wrens, the Thrushes, the Dippers and several other allied families.

From all these considerations the probabilities of the case seem to be, that the Lyre Birds are neither Wrens nor Thrushes, nor members of any other family to which they appear to be most nearly allied; but that they may be the living representatives of a group which preceded one, or either, or all of these various families; and, that under a passerine form, they repeat some of the peculiarities of the Megapodes and of their near connections, *in the line of ascent*, the *Cracidæ* and *Penelopidæ;* at the same time reasserting, in a general way, their resemblance to the Walking Birds, while exhibiting a fundamentally passerine nature. In the same manner does each of the vertebrate classes repeat,

within its own type, characteristics of lower forms of life; and thus do all the higher animals in their embryonic condition, pass through stages representing the lower vertebrates.

MUSSEL CLIMBING.

BY REV. S. LOCKWOOD, PH.D.

CAN any one see a snail travel, and not ask mentally, "how it does it?" The method certainly is curious. A fleshy disk is protruded, and caused to project in the direction of locomotion; it is then spread out flatly, and while slightly adhering to the object over which it is passing, a contractile energy is exerted, and the little animal bearing its house is drawn onward. Thus by the repeated protrusion, expansion, and contraction of this soft organ, in due time its journey is accomplished. Because of this method of progression on a ventral disk, all those shell-fish, or properly speaking, molluscan animals, so constituted, are called by the systematists, gasteropods, a term which means ventral-footed. And in rank these gasteropods stand next to the most highly organized of the mollusca. But some of these shell-encased creatures do not travel at all. Take, for instance, the oyster, called a monomyary, because the valves are held together by a single muscle. This sedate bivalve once settled, probably never moves from that spot. But all

the dimyaries, or two-muscled bivalves, well represented by the common edible mussels, possess a foot, which is not greatly unlike that of the snails. The mussel's foot, however, presents in its class, the least developed condition of this organ, for it is a spinner, rather than a walker; or, as Owen says, "it is subservient to the function of a gland, which secretes a glutinous material analogous to silk, the filaments of which are termed the byssus," which often serves for attachment to rocks. He farther says, "in most dimyary bivalves the foot is an organ of locomotion." Some of the river mussels in babyhood spin a byssus with which to moor themselves against the currents of the stream. When older grown this necessity is overcome, and the capacity just mentioned is lost. Then the adult turns its foot into a plow-share, and is dragged along in the furrow it makes in the mud. The razor-shell alternately bores downwards and propels upward, the foot doing all the work. With the foot as an elastic spring the heart-shell leaps along. But the common black mussel, *Mitylus edulis*, and its despised neighbor, the brown horse mussel, *Modiola plicatula*, who ever saw them walk? Propulsion is not always walking. The scallop with its large adductor muscle, by snapping together its light valves, thus forcibly ejecting the water within against the water without, flits through, and sometimes even skips upon its native element, like an aquatic butterfly. But no pedestrian does so in all Mollusca-dom. Why then should not these pedate bivalves, the mussels, walk as others of their own people do? "For want of brains!" says one. You are mistaken, sir. They have brains, the right kind too, and in the right place,—a real pedal nerve-mass, or ganglion; a little bilobed brain at the very base of the "understanding" itself, that is, exactly under the foot, as was fabled of a very agile dancer, that his brains were in his heels.

Now, if seeing is believing, mussels can walk. We once saw a young brown mussel, of the species *Modiola plicatula*,

about five-eighths of an inch in length, turn his foot to most excellent account. We had pulled the youngster's beard off, and then had deposited him at the bottom of a deep aquarium. The water was probably but poorly aerated, hence he was evidently ill at ease, and to our astonishment he at once began travelling over the pebbly bottom, then up the glass side with the utmost facility and grace. The foot moved precisely as any univalve gasteropod would do, and with the same easy gliding motion. The movement was continued without interruption until it had reached the surface of the water, a distance of not less than ten inches, which added to the distance travelled over the bottom, was probably equal to fourteen inches. At the surface it lost no time in spinning its byssus, which it fixed to the side for a permanent abode.

For its lively colors, perhaps rather ruthlessly, we had picked this little fellow out of a large family cluster, snugly packed in a hole in one of the piles of the dock. It was a large group of all sizes, literally bound together by the silken cords of — attachment shall we say?

A fellow captive was a full grown, black, edible mussel, torn from its anchorage, a stone near by, at low tide. We afterwards found ensconced in this black shell, an amount of intelligence, which filled us with astonishment. If his youthful fellow prisoner could beat him at walking, he was about to accomplish the feat of climbing to the same position by means of a species of engineering of a very high order.

In order the better to understand this singular feat, let us introduce it by the narration of some spider tactics we once witnessed. The insect had captured a large beetle, but could not get it to its web, and seemed indisposed to prey upon it away from its den. It had dragged the prey under the web, which was about two feet above. It ran up to a point close by its web; there it attached a thread, by which it speedily descended, and then attached the other end to its

booty. Again it ascended, affixed another thread, then descended and affixed to the prey as before. Each thread, in sailor phrase, was made taut. After a good many threads had been in this manner attached, each being stretched tightly, and each pulling a little, the weight was seen to ascend a small fraction of an inch. Again the threads were increased, and again the weight ascended a little more, until at last, after incredible labor, perseverance and skill, the little engineer had the satisfaction of success; for its well earned booty, with one final, tiny jerk "brought up" at the desired spot. The explanation of all this is simple. Suppose we take a cord of the material known by the ladies under the name elastic, and attach it to an ounce weight. If but very moderately stretched it would certainly pull at least a grain. Supposing it to do that, a second one would pull with equal force, and it would be but a simple estimate to determine how many threads would be required to raise the entire weight. But enough of this. Now for the mussel.

Placed at the bottom of the aquarium, where it had been for a couple of days, it had succeeded in wiggling itself up to one of the glass sides of the tank. This accomplished it protruded its large foot, stretching it up as high on the glass as it could reach, this organ seemingly adhering very tightly. A little hole opened near the extreme forward end of the foot. This tiny hole was really the extremity of a folded or closed groove. Out of this a drop of white gluten, or mucus, not larger than the head of a pin, was exuded, and pressed against the glass. There was then a slight withdrawing of the foot, simultaneously with an unfolding, or opening of the groove, which contained, as if moulded there, the already completed delicate thread. This done, the partly contracted foot (not drawn into its shell at all, be it understood) was again extended, this time a little higher than before. The groove, or spinneret, was again closed, except the little opening on the surface of the foot, whence another little drop of mucus appeared, which also

was pressed against the glass. Again the foot was withdrawn a little, the lips of the groove unfolded, and the moulded thread set free. This gave thread number two. Each was evidently set at a considerable tension. And in this wise, thread after thread was formed and set. I regret that I did not record the exact number, but am sure that it was about twelve or sixteen, and the time occupied was between two and three hours, when lo! up went the mussel, about three-eighths of an inch high. Yes, he was drawn up by his own cords. He was literally lifted from *terra firma*. Not at all suspecting what was to follow I mentally exclaimed. "This little fellow knows the ropes."

There was next a period of rest. Whether it was due to exhaustion of material, and was meant to allow the secreting gland time to evolve a fresh supply or not, I cannot affirm; but must say that such was my belief, for after an hour or so it set to work again, precisely as before, attaching a new cluster of threads. This cluster was set about five-eighths of an inch higher than the previous one. When this new group of filaments was finished, the same result followed, another lift of a fraction of an inch, but not quite so high as the first. I now suspected its motive—the animal was actually in this singular manner attempting to reach the surface. It wanted to take an airing, and was really in a fair way to bring it about.

While setting its third cluster of threads, I foresaw a serious difficulty in the way, and one against which the spider never has to contend. It was this: after the third lift had been achieved the threads which had accomplished the first lift had changed direction; that is, the ends of the threads, which had pointed downward when pulling up the mussel, were now pointing upward, and were actually pulling it down. Of course the lowermost thread, or threads, would exert the most retrograde traction. Thought I, "Sir Musselman, you will have to exercise your wits now." I rejoice to say that the ingenious little engineer was complete master

of the situation. The difficulty was overcome in this way —as each lowest thread became taut in an adverse direction, it was snapped off at the end attached to the animal. This, as I think, was done by two processes; the one by softening that end of the thread by the animal's own juices, purposely applied, as the pupa in the cocoon moistens its silk envelope, when wishing to soften the fibres, so that it can break a hole through which the imago may emerge; the other by a moderate upward pulling, thus breaking the filament at its weakest point.

The next day our little engineer had accomplished the wonderful feat of climbing to the surface by ropes, fabricated during the ascent. Without delay it moored itself securely by a cluster of silken lines at the boundary where sky and water met, and was there allowed to enjoy the airing it had so deservingly won. Bravo! my little Mussel-man! No acrobat can beat thee on the ropes!

And what are we to say to all this? Blind instinct, forsooth! Who believes it? The wise men of the ages have written as the tradition of the elders—"byssus-bound," of our Mytilus. But it can make of its bonds, mooring lines of safety against the storm, and with consummate skill can build a silken stair-way into its own wished for elysium of delight. It is some three years since the writer witnessed the facts here recorded, and to this day, the sight of a mussel inspires him with profound reflection on the ways of Him who made these creeping things of the sea.

NOTE.—It has seemed to the writer, that in the perfection of movement shown by the *Modiola plicatula*, as given above, a high stage of foot development is indicated, such as would hint at a grade out-ranking *Mytilus edulis*. The figure inserted is that of *M. edulis*; but the process of climbing is the same.—S. L.

FLOWERLESS PLANTS.

BY DR. A. KELLOGG.

THE great coal measures of our continent are the grand storehouses of preserved plants from this richest realm of the vegetable kingdom; they are the entombed pioneers that have paved the way, and still light the path of higher forms of life, both vegetable and animal. However much we may to-day value these humble and lower steps on the stage of existence, we are apt to fall far below a due appreciation of their value in the economy of nature; our health, wealth, comfort, nay our very existence more or less, directly depends on the uses they subserve; and still every new dawn brings some novel use crowding the advancing ages until we look back but a few days to our early years, and wonder how we, as well as our forefathers could do without this or that necessary of life. As coal they are the familiar friends of our labors, and the cheerful companions of the domestic fireside. It is not, however, to the dead and fossilized forms alone, but mainly to the living, that we invite a moment's attention.

An idea of minuteness and insignificance too often follows any reference to the simplest plants in nature; yet many attain a great size, such as Tree Ferns and certain Sea-weeds — the former forty feet high, of the size of one's body, and the latter of prodigious length, besides myriads of intermediate forms.

The Fungi, a brief account of which follows, are cellular plants, without flowers, living in the air, often nourished through a stem by an amorphous spawn, or mycelium, instead of a root, and propagated by very minute spores, serving the same purpose as the seeds of flowering plants.

The largest species found in California, is the kind commonly known as Touchwood, or Hard Tinder (*Polyporus*); of a semicircular shape, between one and two feet across,

and six to eight inches thick; this large species we have only seen attached to the living trunks of the Laurel Tree (*Oreodaphne Californica*). Its name signifying *many pores*, describes itself, the lower surface being a mass of little tubes or pores, angular like honey-comb.

As tinder it makes a slow but sure fire and good coal, wind proof, so that as a slow match for blasting purposes it is perfectly safe. It burns at the rate of an inch in five minutes; this rate, of course, will vary a little with thickness. Dipped in nitre and dried it is even more sure on gunpowder than fate itself. The corky kinds of fungi to which this belongs continue to live and increase for many years, although in general mere size is no reliable index of age in this field of inquiry, for we know that under favorable circumstances the Scaly Polyporus (*P. squamosus*), found on the trunks of dead trees, attains, perhaps, the largest size of any known. Instances have been recorded of its measuring seven feet five inches in circumference, and weighing thirty-four pounds avoirdupois, growing to these vast dimensions in the short space of three weeks.

The power of these plants to disintegrate the hardest wood is very remarkable, causing it to yield much more rapidly than the ordinary influences of the weather. Among the greatest agricultural obstacles in the vast timber clearings of the South and West, and indeed of most new countries, are the old stumps, which, if left simply to the action of the weather, might be something less than half a century in decaying; yet if these were simply sprinkled with water in which fungi had been washed, they would shortly crumble beneath the magician's wand, a mere shreddy mass of interlaced cottony touchwood, the tissues and cells of which would be seen to be traversed and disorganized by this amorphous mycelium. We know from actual observation that where heavily timbered land is required to be cleaned off entirely, it often costs from fifty to one hundred dollars per acre. Perhaps to estimate it in human flesh, we might adopt

the western proverb, that it wears out one generation to bring the land into tolerable tillage for the next. Only a few of these plants are known to us, nor do we know their uses except in a few instances. Many of the species we know are very destructive to the trunks of living trees, on which they grow. In the first instance they may grow on parts which are diseased, but the insidious mycelium spreads with great rapidity; the moment any growth of this kind appears the tree should be felled, or if a valuable ornamental tree, the parts affected should be carefully removed, and a strong solution of sulphate of copper or corrosive sublimate be supplied.

Most Polypori are close and tough in their texture, and rather indigestible; still some are eaten. Berkley declares that the most delicious of all fungi is the *P. casareus*. Several other species besides our *P. igniarius* are used as tinder and moxa, and some are said to make famous razor-strops. Certainly a more satiny cushion could not be devised. The common small species, with variegated concentric rings (*P. versicolor*), is used to lure insects from the mycologist's more valuable specimens. One is used in Russia, pounded and put in snuff, to improve its narcotic properties; another has been manufactured into coarse clothing. Only one, I believe, is worshipped, *i.e.*, the *P. sacer*, a most striking object, much venerated by the negroes on the West African coast.

Perhaps many of us have experienced the kindred pleasures of paradise on a walk in the woods after a thunderstorm in the warm days of August, and felt our lungs swell with a thrill of strength to the very fingers' ends, while breathing the balmy odors of the wood; it was not all the breath of flowers, nor foliage, nor any conspicuous form of commonly recognized vegetation. Some may remember having searched for the sweet knots to take home with them, hiding the uncouth thing in the house in order to excite the pleasing wonder and prying curiosity of the loved ones, as

to where that sweet odor came from! It was the sweet scented Polyporus, another species of the same plant. Similar fragrance is observed in one species growing on the birch which is used to scent snuff; another like the soft contents of the puff ball, is celebrated for staunching blood. This fungus has been much used as a remedy, and its virtues vaunted in this country for the cure of consumption in its early stages; so also have similar surprising effects been attributed to the use of *Agaricus emeticus.* The phosphorescent agarics of the olive and palm are luminous like large fire-flies, and a few suffice to light up a large room sufficient to read by.

It is often said that some allied mushrooms are unwholesome, and therefore there is danger, and upon the whole, it is best to let them alone. In reply, might we not inquire if the carrot, celery, parsnip, angelica and anise are not allied to the deadly hemlock? The potato, egg-plant and tomato are also close akin to the poisonous night-shade. The innocent arrow-root, too, is the actual product of the fearful woorai, or *maratta arunamacea*, with which the savage poisons his arrow-points in war. The universal practice in Russia is to salt fungi; and beside they are often subsequently washed and treated with vinegar, which would be likely to render almost any species harmless. Any one familiar with our coast and bays will not fail to hear of cases of poisoning with shell-fish, and there are also sad cases on record of death from these as well as the edible mushroom, or *Agaricus campestris.* Fungi vary in quality with climate, meteorological conditions, soils, etc., so that the safest way is to eat only those raised in garden beds for the purpose; always bearing in mind that much depends upon the mode of preparation and cooking.

The Grape Disease (*Oidium Tuckeri*), is the result of a parasitic fungus, terribly devastating to the wine crops of Europe, the losses of which are estimated by millions, and so frightful as to threaten starvation to thousands; fortu-

nately, the native vines of America are not subject to it, even when cultivated in proximity, on the European Continent.

This fungus plant is easily destroyed by dusting on them flowers of sulphur with a soft brush, when the fruit is well set, about the size of a pea. One application, the Hon. George Hobler, of Alameda, assures me, has proved an infallible remedy with his foreign grapes; had he known its value sooner it might have saved his English gooseberries, which he had plowed up and cast away in utter despair. Currants, and other fruits, are also victims at times. Indeed, one species, *Oidium albicans*, called Thrush, grows in the mouths of children. This can be transplanted and cultivated; a weak solution of potash or salæratus will dissolve out the albumen and leave the plant wholly exposed and unchanged. Now, the *use* of this knowledge is, that the same law and similar remedies are indicated here, as where it attacks the vine, namely, to kill the parasite and cure the disease. It is always pleasing to be able to see in rational light why our grandmothers were right in being so partial to sulphur. One dram of sulphite of soda to an ounce of water is a sure cure.

The *Oidium fructigenum* is often seen in whitish puberulent spots of a greenish gray on oranges; and on apple trees it destroys the fruit while still hanging to them; beans, plums, peas and hops, etc., are also often destroyed, or much injured by its ravages.

A digression into the rationale of remedies for these evils would greatly interest us, but we must forbear; they turn, however, upon a few simple physiological facts — in a word, the Flowerless Plants on land or sea have an oily or shiny coating to the spores, neither the sea water nor air actually touch them; but the moment this adhesive oily or mucilaginous matter is destroyed, they perish; hence the use of ley, lime, ashes, etc., together with many chemical washes.

It is impossible in a short article like this to dwell upon

all the mildews, white and black (*Puccinia* and *Antennaria*) which ruin wheat fields in the North, and orange groves in the South. Rust, or red mildew (*Uredo rubigo*), which, however, is not so injurious as some others, but is still a serious evil—the smut (*Urego segetum*)—bunt (*Uredo caries*), where the grain looks well, but is a mass of black fœtid sporidia when crushed. If any one of these fungi, out of a thousand, would spread famine and death broadcast over the earth, is it of no use to investigate the subject? As on his rolling main no navigator, coasting its dangerous shores ever contemns the chartings and soundings of science, so let the landlubbers learn to do on theirs.

A brief allusion to a few points in so large a field is all it is hoped to do; but the bald botany of the subject is only to aid the end in view, namely, the practical use of the knowledge; this requires that we add a few words upon the ill effects on men and animals, as well as the gross wealth and prosperity of a country. That the diseased or fungoid cereals referred to are very dangerous to man and beast, no one of proper information will doubt or deny; why they are less dreaded than the larger poisonous fungi, is sufficiently manifest. The Ergot of grasses (e.g. *Agrostis*, *Festuca*, *Elymus*, *Dactylis*, etc.), but chiefly of rye, is one of this class; the fungus is perhaps better known as spurred rye—the symptoms of poisoning from eating it, are general weakness, intoxication, creeping sensation, cold extremities and insensibility; then follow excruciating pains, and lastly, dry mortification—the fingers and toes drop off.

I have known only one case so suddenly serious that the patient lost the fingers and toes; but very many instances where ultimate death of both men and cattle have followed the use of fungoid grain; and also mouldy provisions. Cheese, however, is supposed to be improved by it, and in parts of Europe they inoculate with a plug taken from a mouldy, and introduced into a new cheese; or the curd is exposed for a day or so before making up, so that the float-

ing spores in the air may inseminate the mass. If to some they are improved, there is a species or condition of mould that I have every reason to believe is dangerous to persons of a consumptive predisposition. The black dust of hay fields (*Ustilago*) acts in a more direct manner—hay makers are attacked by violent pains and swellings in the head and face, and great irritation of the entire system. The blue bread mould (*Pencillium*), or a condition of it is found on the inside of casks, the spores of which prove poisonous; this is well illustrated by the two coopers who entered a great tun to clean off this mould, when they were seized with violent pains in the head, giddiness, vomiting and fever, scarcely escaping with their lives.

Alluding to fungi on forests, fruits, shrubberies, grapes and grains, a passing word will not be amiss on the potato disease, caused by the *Botrytis infestans;* its ravages, however, are too well known to this generation for particular details. Another, the *B. bassiana*, attacks the silk worm in China and Syria. The *Achorion microsporon*, *Tricophyton* and *Lychen agrius*, are well known to attack man, to say nothing of the strong probability of their being the origin of malaria, typhus, cholera, and the plague, etc., besides numberless epidemics, which, at least, are preceded and unduly accompanied by these strange and often microscopic wonders of the vegetable kingdom. Unlike other plants the fungi in place of purifying the air—at least, so manifestly—from the poisonous carbonic acid and the other elements of injury, and giving us back the vital oxygen, steal away this, and shed on the shadowing wings of every dark corner of the earth an element, which, if it exceeded a tenth, would annihilate the race; besides all this, they throw off hydrogen, which causes abrasions and sores—mostly of the mucus membranes and air passages; and, finally, as we have seen in some cases, they exhale specific poisonous substances; while myriads of spore-seeds so minute and light as to be scarcely less volatile than ether itself, are poured forth

upon the gentlest breeze, were it even so slight as to leave the gossamer unmoved. Let us not, however, look altogether upon the dark and dismal side of the picture. They all may be, nay, are, beneficent forms of life, only less poisonous and otherwise injurious than would be the fleeting noxious vapors they catch from the atmosphere, as their kindred do the filth of the mighty deep, and hold it back from its fiendish mission of misery to mankind. They come mostly in the melancholy autumn days when the flowers are fading away, and the leaves are falling to decay, when the beautiful fairies have fled from the grassy lawns; when no naiads dance in glee down the glittering wavelets to the boundless ocean; for then even the brook itself loathes and leaves its slimy bed, which, with the aid of crypts, reptiles and creeping things, can scarce suffice to stay or temper the impending plague. Like a grizzly beast of prey, it walks in thick darkness, or sits at bey in the sun-sucked fogs; or, perchance, winds its slow length invisibly along, like a spirit serpent in the stagnant air of the vales and deep mountain gorges; or coils its envenomed form in the dismal cellars and filthy by-ways of our cities. It is notorious that in stagnant water, or in that other fluid, the *air* — where decomposing organisms take on innumerable forms of life — there is the purified and purest portion of the pond. Even the noisome mosquitoes, dragon flies and reptiles, with flowerless plants, render fluids salubrious that were hastening to putrefaction and death.

That like assimilates to like in the realms of spirit and of matter is a universal law that will be seen, and, sooner or later acknowledged. From the vegetable kingdom many examples might be drawn in illustration, and, perhaps, few will be more strikingly in point than the Fly Agaric (*Agaricus muscarius*), so named from its being used to poison flies. This intoxicating fungus is often seen in hilly or subalpine regions, particularly in our forests of fir and birch, where its tall, trim, white stem, and rich scarlet cap, studded with

white, scaly warts, form a beautiful contrast to the soft, green carpet of moss from which it springs, and the elegant emerald foliage that overshadows it. This very poisonous fungus is to the north-eastern nations of Europe and Northern Asia, what opium and hemp are to India and China, awa to the Sandwich Islanders, cocoa to the Peruvians, and what tobacco and various spirituous liquors are to Europe and America. Thus we see, as a reverend writer justly remarks, that the indulgence of these narcotic cravings has at last degraded itself to so low an object in the scale of nature as a common toadstool; and that, too, in the most revolting manner possible to conceive. The Kamtschatkan and Koriac races are so dreadfully degraded that they personify this fungus under the name of *Mocko Moro*, as one of their household gods—like the god Siva of the Hindoo Thugs; if urged by its effects to commit suicide, murder, or some other heinous crime, they pretend to obey its commands, and to qualify themselves for premeditated assassination, they have recourse to additional doses of this intoxicating product of decay and corruption. When steeped in the expressed juice of the native whortleberry, it forms a very strong intoxicating kind of wine, which is much relished. But the more common way of using the fungus is to roll it up like a bullet and swallow without chewing, otherwise it would disorder the stomach. Dr. Greville in the fourth volume of the "Wernerian Transactions," says, one large or two small fungi are a common dose to intoxicate for a whole day, *i.e.*, by drinking water freely, which augments the narcotic action. The desired effect comes on from one to two hours after taking the fungus. Giddiness and drunkenness follow in the same manner as from wine or spirituous liquors; cheerfulness is first produced, the face becomes flushed, involuntary words and actions follow, and sometimes loss of consciousness. Some persons it renders remarkably active, proving highly stimulant to muscular exertion; but by too large a dose violent spasmodic effects are produced.

So exciting is it to the nervous system of many that its effects are very ludicrous; a talkative person cannot keep silence or secrets—one fond of music is perpetually singing, and if a person under its influence wishes to step over a straw or stick, he takes a stride or jump sufficient to clear the trunk of a tree. It is needless to say delirium, coma and death often results as in the case of alcoholic spirits.

The most remarkable fact is that the fluids of the debauchee become similarly narcotic, and are therefore preserved in times of scarcity. Thus a whole village, as some say, may be intoxicated through the medium of one man, and thus one fungus serves to prolong these most fearful and disgusting orgies for many days together. It is worthy of note that the very same erroneous impression as to size and distance produced by this plant, are also created by the *hasheesh* of India, and are also frequently noticed among idiots and lunatics. It has been suggested that many of these may have suffered martyrdom at the stake during the witch mania of Scotland, owing to their natural and temporary defect—*inability to step over a straw* being considered the conclusive test of familiarity with evil spirits. And with those devoted to its intentional use, we should say it really does come within one of it. It is curious to observe how the effects produced by various species of poisonous fungi should be so very similar to alcoholic liquors. The effects in both cases may be traced to a kindred cause. Alcohol, as all know, is the product of fermentation or corruption, arrested at a certain stage of fungoid growth, as also is the case with the yeast and rising process of the pastry cook and brewer. Having, hence, one common origin, it is less wonder their effects should be similar; and, we may add, they tend to produce a like poisoned condition in the human body. This is exemplified in excessive beer and liquor consumers, the slightest accident or even scratch on which will often cause death.

Thus they become the short-lived mushroom humanity

that blooms on the very verge of decay. That these things are nevertheless intended to subserve some good purpose is not denied; every degree of life is wisely provided for, even the worst. This is most manifest from the lowest lichen to the highest vegetable structure; and when mankind observe the true equilibrium of order, the race is justly represented and designated a microcosm, in which from the highest to lowest all things are duly subordinated to an end or use.

The common Puff Ball (*Lycoperdon bovista* and *pratense*) requires special notice. When slowly burnt and the fumes inhaled it produces intoxication, followed by drowsiness and then by perfect insensibility to pain, with loss of speech and motion, while one is still conscious of everything that happens around—realizing the truth that it is possible for one to lie stretched on the funeral bier sensible to weeping friends; aware of the last screw being fixed in the coffin and the last clod clapped down upon us in the churchyard, and yet unable to move hand or lip for our own deliverance. Experiments have recently been made on cats, dogs, and rabbits, and similar effects have been found to invariably ensue. And for ages it has been used in this manner for stupifying bees, and thus robbing their hives with impunity. If the inhalation in man, however, be continued too long, vomiting, convulsions, and ultimate death results.

Much of this lore is still closeted, perhaps, mainly in the secret chambers of the past; the fumes of many plants have been used as spells, enchantments, and to induce spectre seeing, etc., of which we may name some on a proper occasion. In the order of nature, all auras are adapted to human requirements, and under the influence of the last named, unlike our artificial chemicals—chloroform and ethers—the individual remains conscious all the time. I have myself, as well as thousands of others, experienced similar slight trance states of rapture, sweetly and softly celestial, and yet most of all alive to consciousness, with only a dread less some gross vociferous burst from beneath should break the spell; a dread lest some one should speak to you.

That these fungi are sometimes purely meteoric, is proven by their fastening upon iron and rapidly extending themselves; here the matter is manifestly conveyed to them by the air and moisture. Many Polypori, too, grow on hard tufa of volcanoes without a particle of organic matter. Nevertheless, unhealthy conditions of air, soils, and the object attacked, we have often seen to be true concomitants, so that in most cases they may be deemed consequences, rather than causes, if one prefers that view of the subject — our chief concern being a review of the facts. Some of them, indeed, require certain specific conditions so well known that they can be grown to order, leading shrewd observers to the plausible conjecture that they are of spontaneous generation.

Berkley and McMillan, from whom we collate, mention that in Italy a kind of Polyporus, greatly relished, is grown simply by singeing the stump or stems of hazel-nut trees and placing them in a moist, dark cellar; other instances of extinct fires being followed by fungoid scavengers, imps of the pit, are too well known. Now, as charcoal and other black bodies absorb many hundred times their own bulk of fœtid gases — for the color, *black*, is philosophically and devilishly filthy, and it ardently desires or affiliates with, and pertinaciously clings to foul air and odors; and, as a very fiend, only yields them up readily as contagion, eluding, perchance, the alchemist's wand — the vile spell is hardly broken but by that great power of the universe, *heat*. Hence we see why they make such apt servants and meteoric media for their masters, the Fungi. These plants and other parasites sometimes invade living organisms, both animal and vegetable, in their most vigorous state, but we may safely say, in general terms, that whatever fouls or lowers the standard of life in the human, in the animal, or in the plant, surely invites these disorder-inspecting gnomes from beneath; which move to and fro in the earth — messengers of the shades! — ready to alight upon and claim as their own all such trenchers upon the outer realms of death. It is therefore

not wise, neither naturally, morally nor spiritually, to venture too near that other place.

I well recollect, many years since, while residing in the pine forests of Russell county, Alabama, one of my neighbors (Oliver) was desperately annoyed by some mysterious fœtor, like carrion—only more so. A general search was instituted, and at length an abominable fungus was found growing beneath the steps of his log cabin. I have only known of two instances of this kind. It may, however, be common in the piney wood sections of our country. This is a species of *Clathrus*, a putrid, revolting, jelly-like mass of raw flesh just beneath the loosely-lifted soil. It diffuses such a loathsome stench that none could endure it.

One might object that this stench was owing to its putrid state; not so at all; it is the natural fœtor of the fungus, just as we find in our common pole-cat weed and cabbage, several arums, stapelias, etc. Unless the hiding place of this pest is discovered—and little peace is likely to come to the premises until it is—and the intolerable nuisance abated, with its surroundings, they are apt to repeat themselves. There is a popular superstition that if any one should accidentally touch this monstrous mass it would produce cancer. Hence the custom of carefully covering it over with leaves, moss, earth, etc., to prevent the possibility of a contagion. Now, whatever we may *think* of such superstitions, let us *respect*—I had almost said *reverence*—the intuitive promptings from that purer and better world within and above this lower region of filth and contagion, which causes the sensitive and tidy spirit to shudder at, shrink back from and shun such exposures.

We do most solemnly warn the reader that the most vigorous health may not too rashly presume upon a forced, foolhardy or wanton and careless contact with these, or with those *other* fungi—the moral mildews, moulds and blites of man's paradise.

Recent researches seem to show us how little we yet know,

and well do they warn us not to form too hasty conclusions; nevertheless, with one voice they proclaim these fungi to be more abundant and much more important than is commonly supposed. They are undoubtedly the secret or obscure and often unsuspected proximate causes of many diseases of animals and of man—operating either directly or indirectly. We have already seen that the ergot fungus of ill-drained localities found on the Broom-grass (*Bromus*), and Meadow or Spear-grass (*Poa*), etc., but chiefly on the Rye, sadly deteriorates the blood in every degree from intoxication, inveterate ulceration, and mortification to absolute death, or from first to last, both in man and animals. We cannot dwell here upon the indirect dangers of eating the flesh or drinking the milk of such disordered brutes; the effects are scarcely less deleterious than the fungus itself.

These remarks are true in general as respects other causes or other kinds of vicious vegetation. The black dust of hay fields alluded to (*Ustilago hypodytes*) acts directly, throwing one into a most violent and dangerous fever; so also, the spore dust of the common blue mould (*Pencillium*), as in the case of the coopers previously mentioned. Thus we see that these plants act powerfully and strangely on man, whether their etherial fumes are inspired, snuffed, or their substances taken into the stomach, or even vegetate on the outer or inner surfaces of the body. They are also known to abound in the lungs of web-footed quacks, and the brains of many animals, but we believe they rarely reach the brains of some Esculapians.

A French chemist and botanist, M. Dutrochet (as quoted by the Rev. E. Sidney), says he found every sort of vegetable matter, with only a drop or so of almost any acid, yielded a mould; but when albumen contained a neutral salt none appeared. If salts of mercury are present the mould is stopped. On the contrary oxides of lead hasten it; oxides of copper, nickel and cobalt retard it; oxides of iron,

zinc, antimony and other minerals have no effect; all perfumes stop it.

Passing in this flying review some of the lower forms of flowerless plants of forests and fields, with a few parasites on man and animals, only touching here and there an interesting and suggestive fact, we finally offer a word on those found upon our farm fixtures, houses, and especially all timber structures, although not confined to them alone, for even the wall, in the pride of its strength, crumblingly bows beneath their stealthy tread.

Builders have a woful knowledge of numerous fungi found on wood, *e. g.* the *Polyporus destructor*, truly as its specific name signifies, a *destroyer*; also *P. thelephora*, from a Greek word, meaning nipple, by reason of its teated surface; and *P. sporothricum*, from the little pore-tubes having hairy filaments hanging out; the one, however, most familiar to me from my earliest recollection is the Weeping Morel (*Merulius lachrymans*), a crying evil. Both this and the *M. vastator* are sufficiently devastating to all timbers in warm, moist situations where there is no free circulation of air, as in hollow trees, cellars, wainscoting, timbers of ships, sills, sleepers, etc. These invaders, little less than legion, all pass under one common designation, the *dry rot.*

Weeping morels at first appear in a white spot, or point, spreading their filaments flat over the surface of the timber in rounded white cottony patches from one to eight inches broad, and so onwards; near maturity it forms folds of yellow, orange or brown, weeping Madeira wine colored tears; they soon after mature myriads of dirty, rusty-colored sporules which spread destruction far and wide; wood, books and walls crumble in its consuming path; buildings often, though taken down and the stones scraped and fired, scarcely suffice to stay the scourge. Is this the leprosy of the wall spoken of in Leviticus? Heat applied to dry wood only hastens the malady. It can be forestalled by cutting the timber in winter when the sap is out; and, better still, by immersion in

water for a long time, to fully supplant or extract the entire juices, as is often practiced by the best ship-builders and honest wheelwrights, carpenters, etc., who regard a worthy and enduring reputation. It is said that the ships in the Crimea Sea suffered more from this insidious foe than from the ravages of fire, or the shots and shells of their enemies. We have seen samples of this light, crumbly, papery shelled wood, with its weight and strength totally consumed.

A strong wash of corrosive sublimate solution over the timbers of cellars on which these deliquescent or weeping morels so dampen it, are at once rendered dry, and the evil often entirely arrested in the midst of its havoc.

Lastly, most of us have heard, and many have no doubt seen, specimens purporting to be a caterpillar turned into a plant, or some such similar foolishness. We have one in the herbarium which any one may see at their leisure. This is one of those parasitic fungi, that rob and kill in order to supplant and live on others gains; the dying grub's head never sprouts up as a plant, but the seeds or spores of the *Spheria Robertsii* alight upon the caterpillar of a moth, the *Hepialus*, when it buries itself in the mossy woods to undergo metamorphosis, and by its growth destroys the napping grub. Two species of these are used by the Chinese, who sell them in bundles of eight or nine, with the worms attached, which they place in the stomach of a duck and roast for the patient to eat.

VARIATIONS OF SPECIES.

BY A. H. CURTISS.

IN the March number of the NATURALIST we observe an account of a remarkable growth of *Bidens chrysanthemoides*, and as the writer seems to fear that his story may be considered an exaggeration, we come to his support with one

twice as *tall*, which, happily, refers to the most nearly related species, *Bidens cernua.* While collecting along the alluvial, marshy borders of the Potomac below Alexandria, some years ago, we found this species (not before discovered so far south) growing to the extraordinary height of five feet. This, compared with Gray's maximum height, will be seen to be in the ratio of six to one; while in the instance of *B. chrysanthemoides*, it was only three and a half to one. Our press would barely admit of smaller branches, while in collecting the same species in New York, we have easily pressed two entire plants side by side. As if this were not a sufficiently surprising effort of nature, on proceeding some distance farther, we came upon some plants of *Oxalis stricta* (an eccentric plant in more than one respect) fully five feet in height, and widely branched. We do not apprehend that such statements will be discredited by any person familiar with the vegetation of such localities. We mention them as curiosities in vegetable growth, and not as matters worthy of permanent record, or of a place in a work of the nature of the "Manual."

Such variations in the size of plants appear to be seldom attended with any material change of specific characters, and are therefore of less interest than those produced by difference of latitude and longitude, or by change of station, as from wet to dry locations, from sunny exposures to shade, from marine to fresh-water localities, or from mountain to valley, and *vice versa.* These are all fertile in effects of the greatest interest to modern theorists, and no botanist should fail to make them a subject of special study. Such observations inevitably suggest a former unity of many of our species and genera, and result in the correction of too wide distinctions. The two species of *Bidens* referred to, together with *B. connata*, are strongly suggestive of a common parentage; and when *Bidens frondosa* is compared with *Coreopsis bidentoides* (especially since the former has been found with upwardly barbed awns), it is difficult to perceive

a proper dividing line between the two genera. We do not anticipate a loss of the genus Bidens, however, though probably no collector would object to its thorough extermination from our flora, with all its "pitchforks" and "Spanish needles," together with the Desmodiums, which in autumn force the herborizer so extensively into their service in transporting their "fearfully and wonderfully made" legumes.

As examples of the manner in which one genus may merge into another, and one species into another, we cite two instances which have lately fallen under our observation. The first is that of the *Gymnostichum Hystrix* of Schreber. This remarkable grass was apparently separated from the Linnæan genus Elymus, upon the single character of the absence of glumes. In this section of the country, however, we find it with *well developed* glumes, which are *persistent* after the spikelets fall. The glumeless and intermediate forms also occur, but the one most common has rigid, awn-like glumes situated precisely as in *Elymus*, of nearly an inch in length, and with one prominent nerve, being therefore triangular, though appearing terete. We have never found the paleæ dentate (as figured in Pl. 11 of Gray's Manual) in any form of the species, and the "pedicels" are evidently the joints to which the glumes are attached, and are but little longer than in some species of Elymus. Were the spikelets appressed as in Elymus, it would strikingly resemble some species of the latter in aspect, and as there appears to remain no constant technical distinction of any importance, we see no reason why its former name, *Elymus Hystrix* L., should not be restored.

Our second case is that of *Eupatorium aromaticum* L., which we are convinced is but a variety of *E. ageratoides* L. The latter species is very common at the North in low, rich woodlands, and has large, thin and smooth leaves, which, we think, vary very little in size and shape. On reaching Maryland (except in the mountains) and the coast this species seems to be supplanted by one having the same peculiar flower-heads, but lower and less branching, with

smaller corymbs, and smaller, thicker and pubescent leaves. This species is common in Virginia in dry copses and open woodlands, but varies greatly, so that we are puzzled in selecting typical specimens. On coming to the Piedmont region, however, the problem was soon solved, for here we found that it was no longer confined to dry and somewhat exposed and sterile situations, and that in proportion to the degree of shade or richness and dampness of soil in which it grew, so the leaves became thinner and larger, and the whole plant more robust, till it could no longer be distinguished from the true *E. ageratoides;* and on visiting the neighboring mountains, we found the latter species growing in great abundance. If, therefore, the generally accepted rule be applied to this case, *E. aromaticum* must be considered to be a variety of *E. ageratoides.* In a very similar manner *Acalypha gracilens* Gray, varies into *A. Virginica* L., and it has very properly been reduced to the condition of a variety by Professor Gray. In this connection we would mention that we have found *Eupatorium aromaticum* with leaves beautifully whorled in threes. As the same arrangement has been observed in another species, it would seem that the genus is inclined towards this mode of leaf-arrangement, which makes that of *E. purpureum* appear less anomalous.

Before closing we would add to the list of monœcious and diœcious plants which have been found with androgynous inflorescence (see March number of the NATURALIST, p. 46) an instance of the same mode of inflorescence in *Fraxinus Americana.* In the spring of 1867 we observed in this county (Bedford Co., Va.) a tree of this species with panicles thoroughly androgynous; but in this instance, as if a violence had been done to nature, every flower afterwards became changed to a mass of small, contorted leaves, bending the branches with their weight, and presenting a truly remarkable appearance.

NOTE.—*Bidens cernua* and *B. chrysanthemoides* might also have been adduced as species which run together. We beg for a sight of these tall Virginian specimens.—A.G.

A STROLL ALONG THE BEACH OF LAKE MICHIGAN.

BY W. J. BEAL.

THE south-west extremity of Lake Michigan is surrounded by a low, sandy beach, back of which are low land and marshes. Let us take a stroll with our NATURALIST friends along the lake shore south of Chicago. In place of the rocks and sea-weeds, radiates, shells and crustacea of the Atlantic coast, here are only fragments of cork, chips, sticks, now and then a mutilated specimen of an *Unio*, or a few small, dead gasteropods, or their empty shells. Among the land plants we shall find more to interest us. The student from Salem (Mass.), or the coast of New Jersey, recognizes the Beach Pea (*Lathyrus maritimus*) which we believe is never found far from the salt water, except along our great inland lakes. Here also is the Sea-rocket (*Cakile Americana*), a radish-like plant, and the Shore Spurge (*Euphorbia polygonifolia*), growing in the loose barren sand, just as they do near the ocean. Of true marine grasses we find the Sea Sand-reed (*Calamagrostis arenaria*), the graceful Squirrel-tail Grass (*Hordeum jubatum*), and the pest of barefooted boys called Bur-grass or Sand Bur (*Cenchrus tribuloides*), and a rush (*Juncus Balticus*). Our seaside botanist is accustomed to see the Arrow-grass (*Triglochin maritimum*), on every salt marsh. It is likewise common on the marshes a little way back of the lake. In the "basin" near the city flowers a Pond-weed (*Potamogeton pectinatus*). Silver-weed (*Potentilla anserina*), is plenty in the sand, and in some places last season it sent off runners each way full seven feet in length.

We have never seen the Seaside Crowfoot (*Ranunculus cymbalaria*) near the lake shore, but it is very common a little way back on the low pastures and meadows on richer soil. Some of our neighbors tell us that they find the Prickly Pear (*Opuntia vulgaris*) on the bluffs just north of

the city, where it was once much more abundant. The grasses *Calamagrostis longifolia*, Card-grass (*Spartina cynosuroides*), Porcupine-grass (*Stipa spartea*), are common enough and look as though they ought to be dwellers by the sea. We find in the sand beach of the great lakes, Pitcher's Thistle (*Cirsium Pitcheri*), a curious plant which we should look for along the sea beach. It is white, wooly all over, the stem leafy and sprawling, the flowers cream color, and about the size of our common *Cirsium lanceolatum*. The Dwarf, or Sand-cherry, usually trailing six to eighteen inches high, characteristic of true western enterprise, occasionally grows along our shore to the height of eight or ten feet, and has a stem two inches in diameter.

In the walk first proposed one finds thrifty specimens of the Bearberry (*Arctostaphylos Uva-ursi*). Its pinkish white flowers are too pretty to be known by two such long, ugly names, as those given by Adanson and Sprengel. There are now and then tufts of the Early Wild-rose (*Rosa blanda*), abundance of common Milkweed (*Asclepias cornuti*), and *A. obtusifolia*, several Willows and Poplars, Scrub Oak, Shrubby St. John's-wort, Climbing Bitter-sweet (*Celastrus scandens*), Grape-vines, Vetches, False Solomon's Seal, Asters, *Euphorbia corollata*, *Panicum virgatum*, Lead-plant (*Amorpha canescens*), and at the mouth of a brook, its kindred, the False Indigo (*A. fruticosa*), Poison Ivy, and Fragrant Sumach.*

We have found several specimens of the curious *Aphyllon fasciculatum*, a parasitic ghostly plant of the Broom-Rape Family. In August we find two species of Prairie Clover (*Petalostemon violaceum* and *P. candidum*), the former has been pronounced the belle of Chicago, notwithstanding the want of grace in its straight flower-spike. Back in the ponds flourish the Pond-lilies (*Nymphæa odorata* and *N. tuberosa*), and *Nuphar advena*. The Yellow Nelumbo (*Ne-*

* In dry places flourishes a curious Umbellifer, the Rattlesnake-master, or Button-Snake-root, *Eryngium yuccaefolium*), with leaves like the Yucca, and head and stalk resembling the onions of our gardens.

lumbium), has been found in the mouth of Calumet River, ten miles south of Chicago. In the groves are beautiful Violets, Phloxes, *Oxalis violacea*, the unique *Dodecatheon Meadia*; on the marshes Buckbean (*Menyanthes trifoliata*),* Indian Plaintain (*Cacalia tuberosa*), *Valeriana edulis*, and away back on the prairies are hundreds of acres of tall sedges and grasses abounding in several species of *Liatris*, showy Sunflowers, rank Rosin-plants (*Silphium*), and multitudes of Asters and Golden Rods.

REVIEWS.

THE ANDES AND THE AMAZON.†— This racy account of a six months' trip across the continent of South America is really a valuable contribution to American geographical science. The author's "general route was from Guayaquil to Quito, over the Eastern Cordillera, thence over the Western Cordillera, and through the forest on foot to Napo, down the Rio Napo by canoe to Pebas, on the Marañon, and thence by steamer to Pará." This is a new route of travel, and after a trip to the Pacific shores of our own continent, we should prefer this safe, romantic and unfrequented journey to any other we know of. The ascent of the Nile, the great rivers of Asia, and even the Congo itself, are hackneyed subjects compared to scaling the Andes, passing around Chimborazo, and plunging for a long month into the depths of a South American forest, seeking the sources of the Napo River, with that magnificent sail down the Marañon and Amazon to crown all.

As an illustration of the author's pleasant style (though his facts are not always well arranged) we quote his impressions of Chimborazo:—

"Coming up from Peru through the cinchona forests of Loja, and over the barren hills of Assuay, the traveller reaches Riobamba, seated on the threshold of magnificence — like Damascus, an oasis in a sandy plain, but, unlike the Queen of the East, surrounded with a splendid retinue of snowy peaks that look like icebergs floating in a sea of clouds.

On our left is the most sublime spectacle in the New World. It is a majestic pile of snow, its clear outline on the deep blue sky describing the profile of a lion in repose. At noon the vertical sun, and the profusion of light reflected from the glittering surface, will not allow a shadow to be cast on any part, so that you can easily fancy the figure is cut out of a mountain of spotless marble. This is Chimborazo — yet not the whole of it — you see but a third of the great giant. His feet are as eternally green as his head is everlastingly white; but they are far away beneath the bananas and cocoanut palms of the Pacific coast.

Rousseau was disappointed when he first saw the sea; and the first glimpse of Niagara often fails to meet one's expectations. But Chimborazo is sure of a worshipper the moment its over-

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* *Habenaria Calopogon*, three or four species of *Cypripedium*.

† The Andes and the Amazon: or, Across the Continent of South America. By James Orton. With a new map of Equatorial America and numerous illustrations. New York. Harper and Brothers. 1870. 12mo, pp. 356.

whelming grandeur breaks upon the traveller. You feel that you are in the presence-chamber of the monarch of the Andes. There is sublimity in his kingly look, of which the ocean might be proud.

> 'All that expands the spirit, yet appals,
> Gathers around this summit, as if to show
> How earth may pierce to heaven, yet leave vain man below.'

It looks lofty from the very first. Now and then an expanse of thin, sky-like vapor, would cut the mountain in twain, and the dome, islanded in the deep blue of the upper regions, seemed to belong more to heaven than to earth. We knew that Chimborazo was more than twice the altitude of Etna. We could almost see the great Humboldt struggling up the mountain's side till he looked like a black speck moving over the mighty white, but giving up in despair four thousand feet below the summit. We see the intrepid Boliver mounting still higher; but the hero of Spanish-American independence returns a defeated man. Last of all comes the philosophic Boussingault, and attains the prodigious elevation of 19,600 feet — the highest point reached by man without the aid of a balloon; but the dome remains unsullied by his foot. Yet none of these facts increase our admiration. The mountain has a tongue which speaks louder than all mathematical calculations.

There must be something singularly sublime about Chimborazo, for the spectator at Riobamba is already nine thousand feet high, and the mountain is not so elevated above him as Mont Blanc above the vale of Chamouni, when, in reality, that culminating point of Europe would not reach up even to the snow-limit of Chimborazo by two thousand feet.* It is only while sailing on the Pacific that one sees Chimborazo in its complete proportions. Its very magnitude diminishes the impression of awe and wonder, for the Andes on which it rests are heaved to such a vast altitude above the sea, that the relative elevation of its summit becomes reduced by comparison with the surrounding mountains. Its altitude is 21,420 feet, or forty-five times the height of Strasburg Cathedral; or, to state it otherwise, the fall of one pound from the top of Chimborazo would raise the temperature of water 30°. One fourth of this is perpetually covered with snow, so that its ancient name, Chimpurazu—the mountain of snow—is very appropriate.† It is a stirring thought that this mountain, now mantled with snow, once gleamed with volcanic fires. There is a hot spring on the north side, an immense amount of debris covers the slope below the snow-limit, consisting chiefly of fine-grained, iron-stained trachyte and coarse porphyroid gray trachyte; very rarely a dark vitreous trachyte. Chimborazo is very likely not a solid mountain: trachytic volcanoes are supposed to be full of cavities. Bouguer found it made the plumb-line deviate 7′ or 8′.

The valleys which furrow the flank of Chimborazo are in keeping with its colossal size. Narrower, but deeper than those of the Alps, the mind swoons and sinks in the effort to comprehend their grim majesty. The mountain appears to have been broken to pieces like so much thin crust, and the strata thrown on their vertical edges, revealing deep, dark chasms, that seem to lead to the confines of the lower world. The deepest valley in Europe, that of the Ordesa in the Pyrenees, is 3,200 feet deep; but here are rents in the side of Chimborazo in which Vesuvius could be put away out of sight. As you look down into the fathomless fissure, you see a white fleck rising out of the gulf, and expanding as it mounts, till the wings of the condor, fifteen feet in spread, glitter in the sun as the proud bird fearlessly wheels over the dizzy chasm, and then, ascending above your head, sails over the dome of Chimborazo.‡ Could the condor speak, what a glowing description could he give of the landscape beneath him when his horizon is a thousand miles in diameter. If

> 'Twelve fair counties saw the blaze from Malvern's lonely height,'

what must be the panorama from a height fifteen times higher!

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* But Chimborazo is steeper than the Alp-king; and steepness is a quality more quickly appreciated than mere massiveness. 'Mont Blanc (says a writer in 'Frazer's Magazine') is scarcely admired, because he is built with a certain regard to stability; but the apparently reckless architecture of the Matterhorn brings the traveller fairly on his knees, with a respect akin to that felt for the leaning tower of Pisa, or the soaring pinnacles of Antwerp.'

† 'White Mountain' is the natural and almost uniform name of the highest mountains in all countries: thus Himalaya, Mont Blanc, Hoemus, Sierra Nevada, Ben Nevis, Snowdon, Lebanon, White Mountains of United States, Chimborazo, and Illimani.

‡ Humboldt's statement that the condor flies higher than Chimborazo has been questioned; but we have seen numbers hovering at least a thousand feet above the summit of Pichincha. Baron Muller, in his ascent of Orizaba, saw two falcons flying at the height of full 18,000 feet; Dr. Hooker found crows and ravens on the Himalayas at 16,500 feet; and flocks of wild geese are said to fly over the peak of Kintschinghow, 22,756 feet.

Chimborazo was long supposed to be the tallest mountain on the globe, but its supremacy has been supplanted by Mount Everest in Asia, and Aconcagua in Chile.* In mountain gloom and glory, however, it still stands unrivaled. The Alps have the avalanche, 'the thunderbolt of snow,' and the glaciers, those icy Niagaras so beautiful and grand. Here they are wanting.† The monarch of the Andes sits motionless in calm serenity and unbroken silence. The silence is absolute and actually oppressive. The road from Guayaquil to Quito crosses Chimborazo at the elevation of 14,000 feet. Save the rush of the trade wind in the afternoon, as it sweeps over the Andes, not a sound is audible: not the hum of an insect, nor the chirp of a bird, nor the roar of the puma, nor the music of running waters. Mid-ocean is never so silent. You can almost hear the globe turning on its axis. There was a time when the monarch deigned to speak, and spoke with a voice of thunder, for the lava on its sides is an evidence of volcanic activity. But ever since the morning stars sang together over man's creation, Chimbo has sat in sullen silence, satisfied to look 'from his throne of clouds o'er half the world.' There is something very suggestive in this silence of Chimborazo. It was once full of noise and fury; it is now a *completed* mountain, and thunders no more."

The author's description of the great crater of Pichincha is alike interesting. The naturalist will enjoy the sketches of animal and vegetable life, and the physical geology and anthropology of the varied tracts passed over. The map we would draw attention to as undoubtedly the best yet published of the region over which the writer passed. It "was drawn with great care after original observations and the surveys of Humboldt and Wisse on the Andes, and of Azevedo, Castlenau, and Bates on the Amazon." Professor Orton was accompanied by four other gentlemen, and the expedition was sent out under the auspices of the Smithsonian Institution. The specimens of rocks, minerals, plants and animals have been submitted to naturalists, who have mostly reported on them, and many facts new to science in these and on meteorological and geographical subjects have been collected and published by the author. The book closes with a chapter telling us how to travel in South America, with hints about the best routes, the expenses, the best outfit, and the precautions and dangers, with a final word on the consolations of travel:

"As to dangers: First, from the people. Traveling is as safe in Ecuador as in New York, and safer than in Missouri. There are no Spanish banditti, though some places, as Chambo, near Riobamba, bear a bad name. It is not wise to tempt a penniless footpad by a show of gold: but no more so in Ecuador than anywhere. We have travelled from Guayaquil to Damascus, but have never had occasion to use a weapon in self-defense; and only once for offence, when we threatened to demolish an Arab sheik with an umbrella. Secondly, from brutes. Some traveller would have us infer that it is impossible to stir in South America without being "affectionately entwined by a serpent, or sprung upon by a jaguar, or bitten by a rattlesnake; jiggers in every sand-heap and scorpions under every stone' ('Edinburgh Review' xliii, 310). Padre Vernazza speaks of meeting a serpent two yards in diameter! But you will be disappointed at the paucity of animal life. We were two months on the Andes (August and September) before we saw a live snake. They are plentiful in the wet season in cacao plantations; but the majority are harmless. Dr. Russell, who particularly studied the reptiles of India, found that out of forty-three species which he examined not more than seven had poisonous fangs; and Sir E. Tennent, after a long residence in Ceylon, declared he had never heard of the death of an European by the bite of a snake. It is true, however, that the number and proportion of venomous species are greater in South America than in any other part of the world; but it is

* Mount Everest is 29,000 feet, and Aconcagua 23.200. Schlagintweit enumerates thirteen Himalayan summits over 25,000 feet, and forty-six above 20,000. We have little confidence in the estimates of the Bolivian mountains. Chimborazo has nearly the same latitude and altitude as the loftiest peak in Africa, Kilima Njaro.

† Humboldt ascribes the absence of glaciers in the Andes to the extreme steepness of the sides, and the excessive dryness of the air. Dr. Loomis, above quoted, mentions indications of glacial action — moraines, and polished and striated rocks — on the crest of the Cordillera, between Peru and Bolivia, lat. 21° S.

some consolation to know that, zoologically, they are inferior in rank to the harmless ones; 'and certainly,' adds Sidney Smith, 'a snake that feels fourteen or fifteen stone stamping on his tail has little time for reflection, and may be allowed to be poisonous.' If bitten, apply ammonia externally immediately, and take five drops in water internally; it is an almost certain antidote. The discomforts and dangers arising from the animal creation are no greater than one would meet in travelling overland from New York to New Orleans.

Finally, of one thing the tourist in South America may be assured—that dear to him, as it is to us, will be the remembrance of those romantic rides over the Cordilleras amid the wild magnificence of nature, the adventurous walk through the primeval forest, the exciting canoe-life on the Napo, and the long, monotonous sail on the waters of the Great River."

Sketches of Creation.* — The scope of this book is fully set forth in the rather lengthy title. The aim of the author is an excellent one and just such a work as this is intended to be is much needed, and we welcome every attempt at popularizing the latest facts and theories of science. Our ideal of such works as these are the writings of Hugh Miller, Huxley, Faraday, Gosse, Quatrefages, and others, who, added to the charms of a pure, simple, pellucid style, present the story of creation, or a glance at fragments of it, in a thoroughly artless way.

The author of the book before us we regret to say has too often, in these "Sketches," looked at nature with the eye of a melodramatist, and sometimes we are drawn off from contemplating the grandeur of some scene in nature by an illtimed attempt at wit, or an awkward straining at effect; the flash and thunder savor too much of the explosive mixtures of the theatre. In short, in attempting to be eloquent and lively and *Figuieresque*, the author sometimes becomes grandiloquent, and his diction falls far short of the sprightly style of his French prototype. In spite, however, of these faults of style the book is a very readable one; the facts are correctly stated; the theories presented with much fairness; the illustrations excellent, and if the whole book had been as well and simply written as the chapters on salt and gypsum, and oil, where the learned author is fully at home, our duty as a critic would have almost been a sinecure. As regards his choice of subjects lovers of the sensational and marvellous will find their cravings fully satisfied in the chapters entitled "The Ordeal by Water," "The Ordeal by Fire," The "Solar System in a Blaze," "The Reign of Fire," "The Tooth of Time," "The Reign of Universal Winter," "The Sun Cooling Off," and "The Machinery of the Heavens Running Down." When the author has endeavored, as he seems to think satisfactorily, to settle so many vexed points in the science of our day we wonder that he "refrains from the attempt to lift the veil which conceals the destiny of other firmaments!"

We close with a few special criticisms. The Orthoceratite may have been a very formidable monster to a trilobite's mind, but for the life of us we do not understand how, considering the probable structure of the

* Sketches of Creation: a popular view of some of the grand conclusions of the sciences in reference to the history of matter and of life, together with a statement of the intimations of science respecting the primordial condition and the ultimate destiny of the earth and the solar system. By Alexander Winchell, LL. D. With illustrations. New York. Harper and Brothers. 1870. 12mo, pp. 469.

limbs and its stiff armor and its habits of burrowing in the mud, where corals do not usually live, it could when "alarmed, shoot with a quick stroke of his tail under cover of some coral crag." We should rather imagine this acrobatic feat performed by a lobster. And by the way the author is at fault in allying the trilobite to the Idotean crustacean, *Glyptonotus antarcticus*, figured on page 322, when its closest ally is the Horse Shoe Crab, Limulus. Our author adopts the nebulous hypothesis. How can he logically discard a theory of a gradual development of vegetable and animal forms, since the course of nature is apparently the same in both? Why does he reject a fifth subkingdom of the animal kingdom, the Protozoa? The Laurentian Eozoon scarcely conforms to either one of the Cuverian types, and must form a fifth "corner stone on which Nature has built the superstructure of the animal creation" (p. 315). We would question whether there is not a successional relation between the four subkingdoms of animals, as much as in the classes of the vetebrates.

The best authorities agree that the Archæopteryx was a bird, and not a reptile with feathers. Why in figure 98 does our author arm his primeval man with stone axes when attacking the cave bear? Flint, arrow and spear-heads were a "drug" in the Kjoekkenmoedden market. Would not the use of bows and arrows have been better strategy?

We have been informed that Dr. Koch "the reconstructor of the Tertiary Zeuglodon" (see p. 356) is not a man to be trusted in making scientific statements, or reconstructing skeletons of extinct monsters, as his Hydrarchus was fully exposed by Johannes Muller, the great comparative anatomist, and shown to have been composed of the bones of mastodons with a sprinkling of Zeuglodon bones.

HAND-BOOK OF ZOOLOGY.*—In this little manual the author only claims to give a skeleton of the subject, with illustrations taken from species which the student can collect for himself within the limits of British North America, or can readily obtain access to in public or private collections. Fossil animals are included as well as those which are recent, because many types not represented in our existing fauna, occur as fossils in our rock formations; and because one important use of the teachings of zoology is that it may be made subsidiary to geological research." We like this hand-book, notwithstanding what seem to us great defects in the classification of certain groups, and numerous grave typographical errors, both of which could be remedied in another edition. Teachers will find it (when the second part on Vertebrata is issued) the most available book we have in instructing their classes, when books are relied on in teaching a subject where only specimens and oral instruction ought ordinarily to be used. The first and second chapters, on Physiological Zoology and Zoological Classification contain much sound sense, and de-

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* Handbook of Zoology; with examples from Canadian species, recent and fossil. By J. W. Dawson, LL. D., F. R. S., etc. Part I. Invertebrata, with 275 illustrations. Montreal. 1870. 12mo, pp. 264. Price $1 50.

serve to be widely read by a class of half educated "species describers" which vex good naturalists the world over.

We regret that the distinguished author includes the Protozoa in the Radiates, for what radiate feature do the Amœbas, Foraminifera, Sponges and Infusoria possess? Why also are the Tunicates, which homologize so closely with the Lamellibranchs, placed between the Polyzoa and Brachiopods?

We are by no means satisfied with the author's treatment of the class of Insects, comprising in his estimation the subclass Hexapoda and Myriapoda. He considers that there are nine orders of six-footed insects (Hexapoda). He retains the "Aptera" as a distinct order, the types being the Lice and Springtails (Podura,etc.). Now the Lice are proved to be low Hemiptera, and the Springtails are closely related to the Neuroptera, if they do not compose a family of that group. The Coleoptera are regarded as the highest, the Hymenoptera being placed below the Neuroptera even! Notwithstanding all we know of the Fleas, they are also consigned to a separate "order," though proven to be a family of diptera. A very objectionable feature to us is the rank assigned to the Spiders, or Arachnids. They are placed as a "class" above the insects. Their mode of development, their want of a true metamorphosis (except in certain genera of Acarina), their morphology — all convince us that they are inferior to the Hexapoda, and do not show class characters, any more than do the Myriapoda. In his definition of the class the author says "antennæ rudimentary or mandibuliform." The antennæ as proved by anatomy and especially embryology (see Claparède's great work on the embryology of the spiders) do not exist in the Arachnids. The so-called antennæ are the mandibles. What are the "tentacles" in this group, the palpi? Of his order Dermophysa, of which we see no necessity, the Demodex represents a family of the mites, and the Tardigrades are in all probability the types of another and the lowest family of Acarina, while the Sea Spiders (Pycnogonids) are truly crustaceous, as proved very satisfactorily by the able embryological researches of Dr. Anton Dohrn. The Spiders are to our mind higher than the Scorpions and Phrynidæ.

The cuts are for the most part indifferent, and the printing only endurable, while the typographical errors are so numerous, and in some cases so egregious that we suppose the author did not read the proofs owing to his absence in Europe. In a second edition the shortcomings we have plainly alluded to could be easily corrected, and a cheap, practical, very readable and exceedingly useful manual be produced, and one that would deserve a wide circulation.

A Naturalists' Guide.*—This is an excellent little work—one so good, in fact, that we only wish there were more of it. It is difficult, if not im-

* The Naturalist's Guide in collecting and preserving objects of Natural History, with a complete list of the Birds of Eastern Massachusetts. By C. J. Maynard. With Illustrations by E. L. Weeks. Boston: Fields, Osgood & Co. 1870. (For sale at the Naturalists' Agency. Postage paid $1.90.

possible, to give the novice in collecting and taxidermy all the information he requires, in so little space as Mr. Maynard occupies; and in condensing to the utmost, he has left unsaid some things that it would have been advisable to say. If cramped for space the writer might have profitably given up the brief notes upon Reptiles, Fish and the Invertebrates, to make room for more details respecting the taking and preserving of Birds and Mammals — these being evidently his "specialty;" and the loss would not have been great, since the directions regarding the lower animals seem to us too slight and general to be of much real service. Still, attentive study of the book will probably furnish hints and suggestions enough to enable any one to make a good beginning. Regarding the collecting of birds, it gives us much pleasure to observe that Mr. Maynard writes of what he himself knows, and that evidently this is not a little. His notes of the proper times and places to look for birds — of the pleasures and difficulties of taking them — and his pictures of field-work, are true to the life. We have abundant evidence that he has put himself in no danger of tripping by compilation. Thus, for example, his remark upon page 84, "that birds for a certain period increase in size, after which they gradually decrease," is none the less true because it expresses a fact of which few are aware; and it is one not likely to be found out except by long continued and repeated observation. We endorse the observation without reserve. Most birds are at a maximum size before they are perfectly "adult;" on reaching which state, a certain condensation or compaction of the frame seems to take place, so that they become somewhat smaller. Of this the Bald Eagle is an excellent illustration.

The art of preparing birds for the scientific cabinet, no less than that of mounting them for public exhibition or other popular end, is one acquired only by practice, in gaining which we suppose each taxidermist insensibly grows into ways of his own; so that probably no unvarying rules can be laid down. Mr. Maynard's method is different in many respects from the one we have found preferable; yet we do not wish to call it inferior on this account, the more particularly since we have not the pleasure of being familiar with his work, and are therefore not in position to judge of the real merits of his method — still less of the degree of skill he may have acquired in using it. But we are bound to add, that we see no reason why excellent results should not be obtained by following his directions. The whole matter, after all, hangs upon good taste to begin with, then upon nicety of touch, and finally, upon practice. While we have no difficulty in following out his description of the process he employs, we fear it may be found by the beginner a little obscure at places — or at least, not so full and plain as it might have been made. This brings us back to the thought that prompted our opening sentence; we wish the directions were more ample. Nothing is said, for example, of the first difficulty in skinning — that of separating the feathers properly on the abdomen, and keeping them out of the wound afterwards;

nor of the very next trouble — to avoid attempting to take off the thin abdominal walls with the skin, as beginners almost always do. We are in the habit of directing that the cut be begun a trifle above the lower border of the sternum, since, as nothing but skin can be lifted away there, a guide is found at the outset. We think there is a better way of cleaning off the leg and wing muscles than that the writer advises. We nip off the head of the bone by introducing the closed scissors between the muscles, and opening them just wide enough to grasp the bone; then we strip the muscles from above downward, and snip all the tendons at a single stroke below. Practically, with small birds at least, this is done with the thumb-nail, in an instant. Except in the cases of certain long-winged birds, we do not agree with the author that the humerus should be left in; we remove it, and the radius too, leaving only the ulna, which we separate from both the other bones and all the muscles by cutting its head away from the elbow-joint, stripping the muscle off from above downward, and then removing humerus, radius and all the muscle by a transverse stroke of the scissors just above the carpal joint. A description should have been given of the neat and rapid way of removing the brain and all the head-muscles by the four special cuts that may be made in an instant; instead of the general directions for scooping out and scraping the skull. We think the writer hardly puts the tyro sufficiently on his guard against stretching a skin unduly, particularly at the neck, and so producing that ugly bare space on each side, difficult to rectify afterwards. Except in the cases of large birds, where main strength and awkwardness do well enough, no skin should be pulled, or even drawn, off; but should be *pushed* instead; and as soon as it hangs by the neck, with legs and wings dangling, it should be supported in one hand to prevent stretching. For the "make-up" of a skin more explicit directions would not have been amiss; more than one novice will probably do all that he is here told, and then spoil his specimen. We should like to make a few suggestions regarding this matter, but want of space prevents, as it does our even alluding to a score of little points which will not be found in this or any other book on taxidermy that we have seen, but which are nevertheless very good things to know; and after all, a few hours actual practice under the eye and tongue of a competent taxidermist, will be found more valuable than any treatise upon the subject can possibly be made.

In Part II, Mr. Maynard gives what we find to be a very complete and otherwise excellent list of the birds of Eastern Massachusetts. We do not notice a single species that we would erase, and believe that but very few remain to be added. In the nomenclature of the species he adopts the changes that Dr. Coues has shown to be necessary or advisable in certain families; and in matters specific he is nearly as conservative * as

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* Thus he does not admit *Turdus Aliciæ* Baird, *Troglodytes Americanus* Aud., *Ægiothus exilipes* Coues, *Larus Hutchinsii* Rich., and *L. Smithsonianus* Coues. Our *Certhia* and *Eremophila* respectively he refers to the European *C. familiaris* and *E. alpestris*. Whilst our hand is in, we may mention the following cases, all in a single order, where the writer might have con-

Mr. Allen. The notes of habits, etc., are very valuable and useful, and, like Mr. Maynard's directions for collecting, are evidently an original record of the observations of an excellent field naturalist. We have thus the large amount of definite information that is always afforded by *good* local lists. While we believe that the list gives us no actually new names (its main points, if we recollect rightly, having been already presented in the NATURALIST by Mr. Allen), several of the entries are of special interest and importance. Among these may be mentioned *Centronyx Bairdii*, *Argytira maculata* (accidental), *Xanthocephalus icterocephalus* (accidental), *Tyrannus dominicensis* (accidental), *Passer domestica* (introduced), *Chondestes grammaca* (accidental), *Turdus nævius* (accidental), *Helminthophaga peregrina*, *Falco sacer* (unusually southern), *Strix pratincola* (rarely so northern), *Micropalama himantopus* (rare), *Macrorhamphus scolopaceus*, *Thalasseus acuflavidus*, *Pelecanus trachyrhynchus*, and *P. fuscus* (both of these last accidental). The first named Mr. Maynard considers as more likely to be a winter visitor from the north, than a straggler from Nebraska. *Quiscalus major*, *Ægialitis Wilsonius*, and a few other species occurring in Allen's or Coues' lists, he dismisses as resting upon insufficient evidence; probably in most instances he is correct in so doing. The supposed *Buteo* "*Cooperi*" turns out to be a state of *B. lineatus*. A good description of the nest and eggs of *Helminthophaga chrysoptera* is given. The plumages of *Scops asio*, and the relationships of *Sterna macrura* and *S. hirundo*, as well as those of *Troglodytes aëdon* and *T. Americanus*, are discussed at some length. In the case of the *Scops* it is evident that ornithologists will not be likely to come to any agreement, until they conclude, as we did long ago, that the variations in the plumage are purely accidental. In an appendix, Mr. Maynard tabulates all the species in convenient form.

We have been so pleasantly impressed with the book, and others will doubtless find it so useful, that we feel the less hesitation in criticising some things in it that we cannot praise. A little care would have prevented such slips as "carpel" for *carpal* (p. 20), "coccygus" for *coccyx*, or for *os coccygis*, "arctea" for *arctica* (p. 152), "Argyria" for *Argytira* (p. 164), "penguin" for *peregrine* (p. 134), etc. We fear, however, that the writer himself is responsible for such awkward blunders as — "where the humerus joins the sternum" (p. 40); and the mention of the wrists and heels of sheep and deer as "knee joints" (p. 49). The figures we cannot speak well of; in fact, they are very bad, and we should judge that they will hardly answer the purpose for which they were designed. Thus we

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sistently questioned specific validity: *Falco anatum*, *Astur atricapillus*, *Pandion Carolinensis*, *Otus Wilsonianus*, *Brachyotus Cassini*, *Nyctale Richardsoni*. There are many others, as nearly allied to European types, that he allows to stand. Though we agree with the writer in being rather inclined toward conservatism, we could wish that, before discussing the grave questions that arise from our varying acceptation of the term "species," he had adopted a more lucid and less ungrammatical definition than this: "Species consists in a bird's having certain characters so well defined, although inconstant (but never variable beyond a certain point), that it may readily be distinguished from others." (p. 85.)

trust that Fig. 3, Plate VIII, was not taken from an example of the author's handiwork! The book is well printed and handsomely gotten up. We hope it may acquire the popularity to which its merits entitle it.

ORNITHOLOGICAL RESULTS OF THE EXPLORATION OF THE NORTH-WEST.* This memoir gives the first published results of the Russo-American Telegraph Expedition, organized to explore preparatory to the connection of San Francisco and St. Petersburg by electric telegraph. The officers of the company arranged with the Smithsonian Institution and Chicago Academy, in broad and liberal spirit, for the scientific exploration of the country by a corps of young naturalists headed by Major Robert Kennicott. The party left San Francisco in July, 1865, by several vessels, touching at various points, where collections were made. Starting again, July, 1866, after wintering in San Francisco, Mr. Dall visited Plover Bay, East Siberia, and afterward St. Michael's, Norton Sound, where he learned of Major Kennicott's death, in consequence of which the direction of the scientific corps devolved upon him. Messrs. Pease and Bannister accompanied the remains to San Francisco, while Mr. Dall and his party started for the Unalaklik River and the Yukon, reaching Nulato in December, 1866, and remaining there all winter. In the spring they proceeded to Fort Yukon, and then returned to St. Michael's, where intelligence was received of the termination of the enterprise. Notwithstanding this Mr. Dall decided to finish the scientific reconnoissance of the Yukon River, remaining in the country alone and at his own expense. He proceeded with Eskimos to Unalaklik, where he remained until November, 1867, and in March, 1868, went to St. Michael's, after examination of the country both east and west of Nulato. Crossing the portage in June he descended the Yukon to its mouth, and shortly afterward embarked for San Francisco, from St. Michael's, touching at Pribylof and other islands. The ornithological results thus obtained by Mr. Dall and others, during several years of travel and exploration, are worked up in the paper now under consideration, and in the one we shall presently notice.

We find the memoir to be one of special interest and importance, as was to have been anticipated, no less from the character of its authors and of the other naturalists whose collections contributed towards it, than from the nature of the ground explored, and other fortunate circumstances. It is not too much to say that no single paper has appeared for the last decade, and perhaps for a longer period (although we do not forget the results of Mr. Xantus' explorations), that has added so positively to our knowledge of the geographical distribution and habits of our birds, or that has so largely and at once increased our bird-fauna. In noticing so important a contribution to ornithology we cannot refrain from presenting some of the leading points in detail, although even a bare epitome of all the results obtained would exceed our limits. Before so

* List of the Birds of Alaska, with Biographical Notes. By W. H. Dall and H. M. Bannister. Trans. Chicago Acad. Sci., Vol. 1, Art. ix. 1869.

doing we have only to add, in expressing our sense of the intrinsic value of the paper, and in according all the praise to its authors, that they so justly deserve, our impression that the symmetry of the paper is somewhat marred by the circumstances, unknown to us, which resulted in the preservation of the individuality of the joint-authors; not so much from the recurrence of initials, as from the duplication of some paragraphs and the confliction of a few others.

One important result attained, regarding geographical distribution, is the clear illustration of the western trend of the boundary line of the eastern province as this passes northward; so that several characteristic eastern birds occur in "Russian America," either associated with, or replacing, western species whose occurrence was rather to have been anticipated. The fact has been made more and more apparent, of late years, by other collections from the North-west; and the present one may be regarded as demonstrating it. Thus we have *Picus villosus* and *P. pubescens* instead of *P. Harrisii* and *P. Gairdneri*; *Colaptes auratus* instead of *C. Mexicanus*; *Scolecophagus ferrugineus* instead of *S. cyanocephalus*; *Dendrœca coronata* instead of *D. Auduboni*; *Querquedula discors* instead of *Q. cyanoptera*, etc.; with *Seiurus aurocapillus* (though this has lately been known also from the Southern Pacific coast), *Parus atricapillus*, *P. Hudsonicus* ("abundant at Nulato"), *Passerculus savanna* (associated with the three other varieties, or species), *Junco hyemalis*,* *Passerella iliaca*, *Bonasa umbellus*, *Gambetta flavipes*. The presence of "*Uria lomvia*" (*Lomvia troile*), with both *U. Californica* and *U. arra* (*svarbag*), is probably rather a matter of circumpolar distribution. We note on the other hand, among absentees that might have been expected, *Zonotrichia leucophrys*, *Limosa fedoa* and *Numenius longirostris*.

Among the names to which American ornithologists have been more or less unaccustomed for the past few years, changes involving questions of specific relationships, and indications of rare or specially interesting species (exclusive of the additional ones to be presently examined), we notice the following points: *Falco sacer* Forster, is used (by Baird) to "indicate provisionally an ash-colored Falcon, with light transverse bars above, found throughout the Anderson River, lower Mackenzie and Yukon region, breeding on trees and cliffs indifferently. It never becomes white, and does not correspond at all with specimens of either *gyrfalco* or *islandicus*." *Buteo* "*insignatus*" Cass., is given as a variety of *B. Swainsoni*. The old name of *Nyctale* "*tengmalmi*" replaces *N. Richardsoni*, used of late years; as *Picoides* "*Americanus*" does *P. hirsutus*, after Sundevall's recent showing (Consp. Av. Picin. 1866, p. 15). The *Saxicola œnanthe* we presume to be the same bird that was described and figured by Cassin as *S.* "*œnanthoides*" Vig. (Illust. B. Cal. and Tex., p. 207, pl. 34.). Four species of *Passerculus* are recognized in the list, though we should judge that with the exception perhaps of *P. Sandwichensis*, it were

* This probably explaining its occurrence, in Washington Territory (*Suckley*), and Arizona (*Coues*).

difficult to tell them apart. *Melospiza rufina* and *Passerella Townsendii* occurred at Sitka. *Corvus caurinus* continues to be recognized as distinct from *C. ossifragus*. The record of *Actodromus Bairdii* is the north-westernmost as yet; with this and Sclater's recent South American indication it may be considered as an inhabitant of the western hemisphere at large, though it has yet to be detected in the Atlantic province; this, however, may be predicted with some confidence. *Bernicla* var. *occidentalis* is recognized in two specimens from Sitka, as is also *Pelionetta Trowbridgei*; Mr. Dall remarks that "it is not at all unlikely that *B. Hutchinsii* and *leucopareia* are one species." — The party were enabled to make specially interesting observations on some other water fowl, not only of intrinsic value, but demonstrating over again that many, and probably most birds, however "rare" they may be usually considered through default of specimens or other fortuitous circumstances, yet have their "metropolis" or centre of abundance. We may instance in this connection the observations upon *Chlœphaga canagica*, abounding at the mouth of the Yukon, to the exclusion of other species; *Lampronetta Fischeri*, breeding near St. Michael's; and *Somateria v-nigra*, abundant on the north coast. — *Diomedea nigripes* Aud., recently restored by Schlegel and Coues, after being long considered as the young of *D. brachyura*, is stated to be very common in the North Pacific, though not in Bering's Sea. *Larus argentatus* (var.) and *L. brachyrhynchus* are abundant on the Yukon. With the *Rissa tridactyla* "abundant at Sitka and Plover Bay," Mr. Dall has doubtless confounded, since he does not mention, *R. Kotzebui*, a species, or perhaps only a variety, distinguished from *tridactyla* by the remarkable development of the hind toe. *Rissa* "*brevirostris* Brandt" replaces *R. brachyrhynchus*, recognized of late years. The two names undoubtedly refer to the same species; the difference in the color of the legs to which Mr. Dall alludes, is simply a matter of immaturity, or of fading from coral red to yellow in preserved specimens. We do not recollect now which name has priority. *Xema Sabinei*, a species highly prized in collections, was found breeding abundantly about Pastolik and St. Michael's, and was not rare at Plover Bay. *Colymbus arcticus* is recorded instead of *C. Pacificus*, which was to have been anticipated; and the same may be said of *Podiceps griseigena* instead of *P. Holboelli*. The "rare" yellow-billed Loon (*Colymbus Adamsii*), only recognized of late years, was got at Kadiak by Bischoff. Among the Auks the most interesting occurrence is that of *Sagmatorrhina Labradoria* Cass. (*S. Lathami* Bp.), represented by two specimens from Kadiak; these are the first examples of this singular bird that American ornithologists have seen. Bischoff's Kadiak specimens of *Brachyrhamphus Wrangeli* enabled this long obscured species of Brandt's to be restored (Coues, Proc. A. N. S., Phil., 1867, p. 64). The crested *Synthliborhamphus umizusume* might have been anticipated; but only *S. antiquus* is recorded.

Not less important than the record of their geographical distribution, of which we have only outlined some of the more salient points, is that of

the habits of the species observed. "Great care has been taken," says Mr. Dall, "in the record of habits; * * * and it is presumed to be generally correct." Of this we have no doubt, and only regret that we must pass by such a mass of information with only this allusion, in recommending it, as we specially do, to the attentive consideration of ornithologists. The accounts of some of the species are very full, and there are few paragraphs that do not fill some gap in our previous knowledge with highly interesting matter.

Mr. Dall includes in the list *Vanellus cristatus*, from a description given him by a hunter of a bird killed on an island off the Golsova River, and which "could apply to no other bird of the country;" no specimens, however, were taken. The other actual additions to our bird-fauna, though of course contained in the present list, are treated of at length in an immediately succeeding paper,* that presents the pith of the discoveries. Of the sixteen species here described or otherwise noticed, one, *Spermophila badiiventris* (Lawr., Ann. Lyc. Nat. Hist., N. Y., 1865, p. 172), is Nicaraguan; the others are from the North-west; some are well-known old-world species, new to our fauna; others have been separately described as new by Cassin, Elliot and Coues, of late years; while others still are here presented for the first time. The most interesting of these are doubtless the three that respectively introduce to our fauna as many genera previously known only as old-world. *Pyrrhula* is represented by a variety (*Cassini* Baird) of *coccinea;* "the color of the under parts, if really characteristic of the adult male, will at once distinguish it, in being light cinnamon gray, as in the female *coccinea*, instead of bright nimium red" (p. 316); the single specimen is from Nulato, January 10, 1867. The other two are *Phyllopneustes Kennicottii* Baird (one specimen, St. Michael's), closely allied to *P. trochilus* and *Eversmanni;* and a *Budytes*, which Professor Baird says he is unable to distinguish from the protean *B. flava* of Europe and Asia. It is singular that this last should have been so long overlooked, judging from Mr. Bannister's account. He says (p. 277): — "I first observed this species at St. Michael's about the 9th or 10th of June, and from that until well into the month of August; they were among the most abundant birds, perhaps, after *Plectrophanes lapponicus*, the most abundant of the strictly terrestrial species. During the month of June I observed them generally in flocks of from twenty to thirty individuals."

Scops Kennicottii (Elliot, Proc. A. N. S., Phil., 1867, p. 69, and Ill. B. Am. pl. x, one specimen, Sitka), is a large, dark, northern form, close by *S. asio;* probably representing one extreme, of which the small, pale southern *S. McCallii* is the other. *Troglodytes Alascensis* n. s., is a curious species, like *T. hyemalis* in shape and generally similar to it in color, with the size of *T. ædon;* "of its distinctness from any other North American species there can be no question" (p. 315). *Leucosticte griseinucha* Brandt,

*On Additions to the Bird-fauna of North America, made by the Scientific Corps of the Russo-American Telegraph Expedition. By S. F. Baird. — *Ibid.*, p. 311. (Art. x.)

(Aleutian Islands), noticed in 1858, by Professor Baird, though not formally introduced for want of specimens, is here more definitely characterized; and one *L. littoralis* n. s. (Sitka and Fort Simpson) is described; the latter is considered to be what Elliot figured under the name of *griseinucha* (nec. Brandt), than which species, however, it "is considerably smaller; the colors are brighter and lighter" (p. 318), and the colored areas upon the head are somewhat different. *Melospiza insignis*, n. s. (Kadiak), "is another of the perplexing species allied to the song sparrow of the Eastern United States, and although apparently very distinct * * * is yet traceable into it" (p. 319). *Limosa uropygialis* Gould, auct. (*L. Foxii* Peale), a well-known and extensively distributed old-world species, was found "very common at the Yukon mouth, and on the Pastolik marshes to the north of it" (Dall, l. c., p. 293). *Sterna Aleutica* n. s. (Kadiak), the single specimen of which we have had the pleasure of inspecting, is a remarkable tern, with something of the appearance of *S. arctica*, close to which it must be placed; it has a black bill and feet like *Haliplana*, frontal white lunule like that genus and *Sterna minuta*, etc.; white tail, and body coloration not quite like that of any tern we know of; truly presenting a singular combination. *Graculus bicristatus* (Pallas, Zoog. R. A. ii, 183), is the name conditionally applied by Professor Baird to a bird from Kadiak, which he identifies with much hesitation. As is well-known, the cormorants are in a confused state at present, and will require thorough revision before the perplexity now attending their determination can be removed. *Puffinus tenuirostris* (Temm., Pl. Col. No. 587) is a well-known shearwater from Japan, etc., now introduced from Kotzebue Sound (Dall); Schlegel has it from Sitka. *Fulmarus Rodgersi* (Cassin, Pr. A. N. S., Phil., 1862, 290, and Coues, ibid., 1866, p. 29), first described, as just quoted, from the "North Pacific," was taken at St. George's Island, Mr. Dall's specimen making the first discovered since the type; it is chiefly distinguished from *F. glacialis* by the white on the inner remiges. The fifteenth species is *Larus borealis* Brandt, which Professor Baird very truly says "is hardly to be called a species." We doubt the propriety of recognizing it, since it is nearly *L. Smithsonianus* with a slightly darker mantle; further south on the Pacific coast *L. Smithsonianus* is not distinguishable in any respect from the common bird of the Atlantic states; and while *L.* "*borealis*" may be said to form the connecting link, in respect of the color of the mantle, between this and the Californian *L. occidentalis* Aud., it appears to lack the great depth of bill which is a strong character of the latter. The last species that Professor Baird gives is the *Simorhynchus Cassini* (Coues, Pr. A. N. S., 1868, p. 45), from Ounimak Pass; a species near *S. tetraculus*, but much less in size, with a remarkably small, simple bill, and dusky, leaden colored plumage.

In closing a rapid analysis of these two very interesting and important memoirs, we have only to add further, that they are accompanied by a number of colored plates, well illustrating all the new species, and the other additions to our fauna.

GEOLOGY OF INDIANA.* — This survey has evidently begun in earnest. The present volume informs us that it is instituted to make known the mineral resources of the State, but does not state the amounts appropriated; we hope, however, it is proportionate to the practical benefits already conferred by the Survey. The geology of the counties examined, Clay, Greene, Park, Fountain, Warren, Vermilion and Franklin, display rich fields of coal, and are full of practical details which seem to have already more than tenfold repaid the expenses incurred. From Greencastle to Terre Haute a section has been run along the railroad line and by means of two Artesian wells the strata sounded to a considerable depth. These have enabled the Survey to give a very interesting section showing the strata from the Silurian to the surface. The first one at Terre Haute penetrates first the glacial deposits and reaches to the depth of one thousand seven hundred and ninety-three feet, stopping in the subcarboniferous rocks; the second at Reelsville, begins where the subcarboniferous limestone comes to the surface farther east, and though bored only one thousand two hundred and forty feet, penetrated the Upper Silurian.

The present report is concluded with a catalogue of the Mammals and Birds of Franklin County.

The assistants engaged in the Survey are Professor F. Bradley, Dr. Rufus Haymond, and Dr. G. M. Levette. The two former contribute largely to this volume; the report of the first on Vermilion county being particularly full and complete. We hope that no short-sighted economy will cut this survey short as that of Iowa has been before it has thoroughly worked up the natural history of the State.

RUDOLPH'S ATLAS OF THE GEOGRAPHY OF PLANTS. — There is, as I understand, an "Atlas der Pflanzen geographie," by L. Rudolph, of which a second edition has been published in Berlin, and recommended for translation into English, and introduction into our high schools. I possess the first edition, but I do not know whether the new one is as worthless as the first one is. If this is the case I do not understand how such a product of the utmost ignorance could be recommended, though the great Humboldt, to whom the work is dedicated, had already puffed it, probably without ever having looked at it. To prove my assertion I will point out the following errors in plate "North America" of the first edition. Between 34° and 45° north latitude in Oregon and California we find sixteen plants mentioned, of which not a single one grows there, *i. e.*, *Rudbeckia pinnata*, *Fraxinus Americana*, *Aristolochia sipho*, *Smilax sarsaparilla*, *Quercus tinctoria*, *Q. castanea*, *Ampelopsis bipinnata*, all eastern species; *Tagetes patula*, *Tagetes erecta*, *Lobelia splendens* and *fulgens*, *Georgina variabilis*, *Cobæa scandens*, *Convolvulus Mechoacana* (Mexican species), *Smilax officinalis* (Mexican when of Presl, South American when the plant

* First Annual Report of the Geological Survey of Indiana. By E. T. Cox, State Geologist. 8vo. pp. 240, with two maps and one section.

of Humboldt and Bonpland is meant) *Fraxinus heterophylla*, a European tree! The *Vanilla*, *Cacao* and *Quinoa* cultivated in the desert west of the Colorado! *Zinnia elegans*, *Georgina coccinea*, *Ipomea purga* are all placed too far northward. *Robinia viscosa* and *hispida* between the upper Missouri and Rocky Mountains, with *Gleditschia monosperma* and *G. triacanthos* in Northern Wisconsin; *Rosa suavis* and *Americana*, quite unknown species; *Pinus palustris* on McKenzie River!! *Pinus occidentalis* from West Indies, transplanted to the North American continent; *Juglans olivæformis*, our *Pecan* and *Castanea pumila* in the Rocky Mountains, and *Kalmia cuneata* on the Red River; *Aristolochia officinalis* (probably *Serpentaria*), *Bignonia capreolata* in Michigan; *Diospyros Lotus* an European tree; almonds and figs cultivated near Lake Ontario! And so on! Should all these errors be reproduced in the second edition, the introduction of the work into our schools will be a great nuisance. — F. BRENDEL.

NATURAL HISTORY MISCELLANY.

BOTANY.

DIALYSIS WITH STAMINODY IN KALMIA LATIFOLIA. — These two technical words we take from Dr. Masters' interesting volume published last year by the Ray Society, entitled "Vegetable Teratology," which last word denotes the science of monstrosities. *Dialysis* is the term applied to the separation of parts which are normally united; *staminody* is the conversion of other organs into stamens.

We have before us a novel and specially interesting monstrosity which is described by these terms. It was discovered by Miss Bryant, at South Deerfield in this state, and we are indebted to her, through a common friend, for the specimens before us. Among the shrubs of *Kalmia latifolia* which abound in a swamp belonging to Col. Bryant, a few have been noticed as producing, year after year, blossoms in singular contrast to the ordinary ones of this most ornamental shrub, and which, indeed, are more curious than beautiful. The corolla, instead of the saucer-shaped and barely 5-lobed cup, is divided completely into five narrowly linear or even thread-shaped petals. These are flat at the base, and scarcely if at all broader than the lobes of the calyx with which they alternate, but above by the revolution of the margins they become almost thread-shaped, and so resemble filaments. This resemblance to stamens goes further; for most of them are actually tipped with an imperfect anther; that is, the corolla is separated into its five component petals, and these transformed into stamens. Altered as they are in shape, yet a trace of the pouch is often discernible, in the form of a little boss on the outer or lower side, and a slight corresponding depression on the upper. The anther is ex-

trorse and adnate, usually subapical rather than strictly terminal, and its two cells incline to open lengthwise. The ten proper stamens are just as in the normal flower, except that they are erect or at length recurved, and the anthers wholly free, there being no pouches to receive them. The pistil is wholly normal, and there is nothing apparent to prevent the ovules from being fertilized and maturing seed. — A. GRAY.

OCCURRENCE OF RARE PLANTS IN ILLINOIS. — There are in "Gray's Manual" some species noted as rare which grow in the vicinity of Peoria: *Silene nivea* DC., *Napæa dioica* L., *Polygala incarnata* L., *Cacalia suaveolens* L., *Asclepias Meadii* A. Gr., *Pogonia pendula* Ldl., *Liparis Lœselii* Rich., *Aplectrum hyemale* Nutt., *Panicum autumnale* Bosc., *Zannichellia palustris* L., in great abundance; and in St. Clair county, *Eleocharis quadrangulata* R. Br.

There are a number of species which could, from the habitats given in "Gray's Manual," be taken as not growing in Illinois, though they do; they are *Arenaria lateriflora* L., *Flœrkea proserpinacoides* Willd., *Agrimonia parviflora* Ait., *Archangelica atropurpurea* Hoffm., *Lonicera flava* Sims, *Aster æstivus* Ait., *Solidago neglecta* T. Gr., *Gnaphalium purpureum* L. (only one found), *Troximon cuspidatum* Ph. (noted as reaching to North Illinois), *Arctostaphylos uva-ursi* Spr., *Lysimachia thyrsiflora* L., *Utricularia intermedia* Hayne, *Phlox reptans* Michx.(?), *Fraxinus sambucifolia* Lam., *Aristolochia serpentaria* L., *Dirca palustris* L., *Carya tomentosa* Nutt., *Salix myrtilloides* L., *Orchis spectabilis* L., *Trillium nivale* Ridd., *Triglochin maritimum* L., *Potamogeton pectinatum* L., *Allium tricoccum* Ait., *Carex arida* Schw. Torr, *C. filiformis* L., *C. lanuginosa* Michx., *C. longirostris* Torr., *Equisetum variegatum* Schleich., *Asplenium angustifolium* Michx., occur around Peoria.

I have seen *Arabis lyrata* L., on the limestone rocks near Galena, and *Collinsia verna* Nutt., in Fulton county. In Southern Illinois I have collected *Vitis indivisa* Willd., *V. bipinnata* T. Gr., *Heuchera villosa* Michx., *Fedia radiata* Michx., *Celtis Mississippiensis* (near Cairo) *Quercus phellos* L., *Cyperus virens* Michx., *Paspalum Walterianum* Schult., *P. læve* Michx., *Camptosorus rhizophyllus* Link (at Falling Spring, opposite St. Louis). — F. BRENDEL.

ZOOLOGY.

EARLY ARRIVAL OF GEESE. — A flock of forty geese (*Anser Canadensis*) were observed passing over Glace Bay, Cape Breton, steering north on the 23d of February. This is at least a fortnight earlier than I have ever known them to appear in Nova Scotia. — J. MATTHEW JONES, *Halifax, N. S.*

HYBRID FOWLS. — In answer to a query in the NATURALIST for March, as to the hybridation of Pintados, I might state that an instance of the kind alluded to came under my notice in the year 1845, where the cross was the more singular one of a male turkey and a female Guinea hen.

There were upwards of twenty eggs laid by the hen, and incubation had progressed until within about two days of hatching, when a marauding opossum found the nest and destroyed all but two of the eggs. These were hatched, and grew to maturity, evincing a singular combination of the form and habits of their incongruous parentage.

The birds were forwarded to the Academy of Natural Sciences of Philadelphia, where their skins were mounted, and I believe are still to be seen. I forwarded an account to the Academy at the time, and they were made the subject of a report by the late Dr. Morton. I have not the Proceedings of the Academy by me, but I believe the account will be found in the volume for 1846.

The Guineas are very strong in their attachments, and the old gobbler had to do the agreeable to his wife and children all summer whether he would or no. — WILLIAM KITE.

We have at the Central Park a pair of hybrid fowls, which I consider as a cross between the common and Guinea fowl. They are large boned; have the cackel but not the horny casque and wattles of the Guinea fowl. Instead of the feathers being speckled they are marked with fine wavy lines. Tegetmeier says the hybrids between these fowls are rare but when produced are perfectly sterile, being incapable of reproduction between themselves or with either of the species from which they were derived. — WILLIAM A. CONKLIN.

In answer to a query in the NATURALIST of March, I would say that there was a fowl in St. Augustine of this state, that was a cross between the dung-hill fowl and Guinea hen. I have heard of two other instances, but have no positive proof, except in this one instance. — C. H. NAUMAN.

HYBRID RABBIT. — On the 13th of October a rabbit was shot in the woods in this vicinity, which the most superficial observers readily decide to be a hybrid between our common wild rabbit and the English domesticated species. Both are common here; the former in a wild state, the latter in coops and pens, from which they often escape to the adjacent woods. In this individual the characters of the two are so equally blended as to leave no doubt as to its parentage. It is well mounted in my cabinet. — J. P. KIRKLAND.

TURKEY BUZZARD. — Can a Turkey Buzzard be deceived by his sense of smell? I have noticed several instances in which skunks have been eaten by buzzards within a few hours after they were killed; and in all cases the creature had given out a great amount of his odor; those which were odorless being allowed to lie as long as other animals. Did the buzzards mistake the skunk's scent for putrefaction? — J. L. B., *Colora, Md.*

DOUBLE HEADED SNAKES. — Within the last ten years I have had in my possession two specimens of doubled headed Snakes. One was accidentally lost, the other is before me, preserved in alcohol. The latter lived some weeks after it was captured and would sustain itself on flies which it seized with one of its mouths; the other seemed always to be passive

and of no use. Both specimens were the young of our Water Snake, *Regina leberis* of B. and G. — W. Kirkland.

Reproductions of Limbs. — M. Philippeaux has proved for fish what he had already demonstrated in the case of newts, *viz.*: that when the limb is removed below the scapula or ilium it is reproduced. But when the scapula or ilium is removed no reproduction takes place. — *Monthly Microscopical Journal.*

Does the Prairie Dog Require any Water? — The following may throw some light on the question. October 26th, 1869, I received two prairie dogs from Cheyenne. The dogs were kept in my laboratory under my own eye, and I am *sure* have drank no water from that time to the present, nearly six months. March 11th and April 3d I placed a dish of water before them. Each time they merely smelt of it, and turned away without drinking a drop. They were fed on nuts, corn, apples, cabbage leaves, celery tops, etc. During the months of December, January and February, they were taking their winter nap, and of course ate nothing. B. C. Jillson, M. D., *Pittsburgh, Pa.*

An Albino Turkey Buzzard (*Cathartes aura* Illig) was shot near here about a month since, and a white black duck (*Anas obscura* Gm.), was seen a few days ago. — Charles H. Nauman, *Smyrna, Fla.*

Albino Snow Bird. — November 16th last, I shot an albino snow bird, *Niplecea hyemalis.* The bird was with a flock of its species, and attracted my attention by its singular whiteness. It is a male, and possessed no peculiarity that I have discovered except its plumage, which was chiefly snow-white. — William P. Alcott, *North Greenwich, Conn.*

Albino Rats. — Colonies of albino rats are becoming quite common in the city of Cleaveland and its suburbs. I have a live specimen caged, which if freed from its odor, would form an interesting pet. Its fur and hair are pure white, and its eyes pink colored. No squirrel could be more active and playful. Much of its time is spent in washing its face and smoothing down its coat of hair and fur.

The Little Striped Skunk in Central Iowa. — An animal of this beautiful species was killed in this town (Grinnell, Iowa), February 12th, and brought to me to be stuffed for the College cabinet. It has been considered a Texas and California species, but I am informed by Professor Baird that it has been found as far north as Neosho Falls, Kansas; also that he regards the markings as distinctive of the species. My specimen is not much larger than a Western Fox Squirrel. It has all the characters of *Mephitis bicolor* Gray, as described in Baird's "General Report." — H. W. Parker, *Grinnell, Iowa.*

The Ruby Crowned Kinglet. — In regard to the query of Mr. Allen about the ruby crowned kinglet, I would say that I obtained ten or twelve specimens in May and June on the Yukon River, Alaska, all of which had the red crown, and proved on examination to be males. I never saw a

female of this species in that region, and noted the fact as remarkable at the time.

I notice among the notes in regard to the Massachusetts ducks, the statement that the mallard pintail and black duck do not dive for their food. My own observations do not entirely confirm this theory. The black duck is most common on the lagoons in the low ground of the Yukon marshes, and, with others, feeds principally on the roots of the *Equisetæ*, which in the spring are under water from six inches to two feet, until the river falls and leaves them dry, or nearly so. I cannot say that I have seen them dive often, but I have certainly done so on one or two occasions. This species was not found on the sea-coasts of that region.

The pintail is very common on both coast and river, and I have seen them dive apparently for food, hundreds of times. Indeed, they are extremely expert at it, and are only excelled by the true sea ducks, such as the old squaw. The same is true of the mallard, which is more common on the deeper lagoons and on the coasts, than on the shallows by the river, according to my observations. It is, however, not impossible that their habits may vary somewhat in different localities. — W. H. DALL.

THE MARSH HARRIER. — About all our meadows and wherever mice are numerous this beautiful species is very abundant. During the past and present month we have seen, we believe, at least a hundred of them, *all females*. Where are the pale blue gray male birds? We have yet to see the first specimen this year. We have never seen a dozen in as many years. Is this absence of male harriers as noticeable elsewhere? Have others called attention to it? This species, *Circus Hudsonius*, nidificates in this state, yet even in the neighborhoods of the nests, we have been unable to find the male bird. We have noticed this hawk lately engaged in tearing open the ridges formed by the burrowing of the mole (*Scalops aquaticus*), and once saw the bird overtake and kill the beast, but it would or did not devour it. Will any hawk eat so offensively smelling an animal as this *Scalops* is? — CHARLES C. ABBOTT, M.D.

NIGHT HERONS. — During the past four months a yard within city limits, in Trenton, N. J., bordering on the river, and having considerable left it of undisturbed nature, has presented a feature of interest, in the daily presence of a male, female and three young night herons (*Nyctiardea Gardeni*). This bird is common with us during the summer, but not about the usual thoroughfares, or even by-ways of the people. They breed in unfrequented swampy localities exclusively, when with us. Stragglers are occasionally met with about springs in mid-winter, but never before, as in this case, in town. The little colony mentioned remain during the day in the large pines in the yard, seldom moving about until sundown, when they visit the little pond, and spring brook in the grounds, which, in consequence of the mild winter, have remained comparatively warm, and the vegetation about them green. In this pond the

frogs have been as active and abundant as during the summer, which fact we suppose has been the principal cause of the continued presence of the herons. On these frogs and the many gold-fish, these birds have subsisted daily since early in November. Occasionally they have visited the river shore, but not from the river have they apparently secured any important quantity of food. These five birds are probably a family raised in the neighborhood, and must have remained together during the early autumn, which is an unusual proceeding. It will be of interest to watch their farther movements to see if, during the coming summer, they will be as indifferent to the proximity of man, and if next winter they will also remain in a yard in town. — DR. CHARLES C. ABBOTT.

SONG OF THE SONG-SPARROW. — Throughout the winter, and at this time (April 11th), we are having with us a great abundance of sparrows, especially the one above mentioned (*Melospiza melodia*). While their numbers have been generally noticed and commented upon, there has been one other feature connected with them, that to an ornithologist is interesting and equally noticeable, *i.e.* a marked change of notes or song. In fact, this change induced me to think, at first, that the new notes were those of another bird; but a careful examination has shown the birds of the new and old song, to be one and the same. We have *seen* as well as heard the same bird warble first the old time song and follow immediately with the new notes. Giving, as the best illustration of their old song, *Pres-pres-pres—Pres-by-teee-rian;* we can best show the variation by describing the new as *Fee-o, Fee-o, twit-ta, twit-ta, twit-ta, fee!* Hearing these notes, at first, in the one locality (Trenton, N. J.), we thought possibly they might have been uttered by but one individual; but since, we have shown this not to be the case, by finding the same variations of song, in various and widely separated localities. Is such a change of notes a common occurrence, in a species having so uniform a song as this species is known or supposed to have? — CHARLES C. ABBOTT, M. D.

GEOLOGY.

GEOLOGICAL EXPLORATIONS. — Professor C. F. Hartt of Cornell University, with his associate, Professor A. N. Prentiss, and nine assistants, sailed June 23 for Brazil, to study the geology of north-eastern Brazil and the right bank of the Amazon. Another aim of the expedition is to explore the coast from Para down to Pernambuco, and investigate the coral reefs of this part of the coast.

About the same date Professor O. C. Marsh, of Yale College led an expedition, composed of students and recent graduates, to the Rocky Mountains, where he will spend several months and collect the vertebrate fossils of Nebraska, Dakota, and Wyoming. The party will then go to California, and visit some of the principal geological localities on the Pacific coast, after which they will return through Colorado and Kansas, reaching New Haven probably in November.

Restoration of the Dinotherium. — I enclose an outline restoration of the Dinotherium, that I found lately among the St. Petersburg Transactions, presenting the latest ideas of Dr. Brandt in regard to that animal. — S. F. Baird.

Fig. 84. Restoration of the Dinotherium.

MICROSCOPY.

Development of Gas in Protoplasm. — Dr. Th. Engelmann has observed in *Arcella*, a minute protozoon like an *Amœba* with a shell, a periodical development of gas. Dr. Engelmann made his observations on specimens confined in a gas chamber, and describes minutely how gradually in the protoplasmic hyaline substance of the animalcule, black points arise, which as gradually coalesce, forming a distinct air bubble. This gas can after a time be absorbed again, and reasons are given for believing that a sort of volition is exercised by the *Arcellæ* in the secretion and

absorption of the gas which they use in the manner of a float or air-bladder. The air-bubbles are not connected with the contractile vacuoles, or with the nuclei. The air-bubbles it is important to observe, do not occur in the non-granular protoplasm of the pseudopodia, but in the granular substance, and are not spherical but of an irregular form, which as Dr. Engelmann observes, proves that the protoplasm is not in the condition of aggregation of a fluid. The chemical composition of the gas thus so remarkably developed by the *Arcellæ* was not determined, nor the mechanism (if any exist) of the formation and disappearance of the air-bubbles. The discovery is of importance from two points of view: in the first place, for the development of gas in protoplasm as a physiological phenomenon; in the second place, for the supposed voluntary nature of this development, of which this exceedingly simple organism makes use for the purpose of locomotion.—*Quarterly Journal of Science.*

The Largest Infusorium Known. — In the "Institut" of the 24th of January is an interesting paper on the Gregarinadæ, which are well known to represent one of the simplest forms of animal life, consisting of a nucleated cell, which under certain conditions invests itself with a transparent membrane, becoming, as it is termed, incysted. The nucleus disappears and the substance of the body then breaks up into innumerable sporosperms, navicellæ, or elongated minute corpuscles, which, being set free by the bursting of the enclosing capsule, become distributed in the various organs of many animals. A well-marked form is found in the alimentary canal of the common beetle. M. Edouard v. Beneden has lately discovered a remarkable form, to which he has applied the name *Gregarina gigantea*, in the intestine of the lobster. It has been subjected to MM. Gluge and Schwann of the Académie Royale de Belgique for examination, and they report that its length is no less than 16 mm., and its breadth 15 mm., or nearly two-thirds of an inch. It presents, in the membrane which forms its wall, a contractile layer, to which M. Beneden had previously called attention in other species. The interior of the animal is occupied by a viscous liquid containing granular particles, with a nucleus and nucleolus. This last exhibits a remarkable phenomenon. At first it is single, but in the course of a few seconds the nucleus appears to be filled with a large number of small refractile corpuscles, which are so many nucleoli. Some of them then augment considerably in size, whilst the primary nucleolus gradually disappears. With the exception of the yolk of the egg of birds, and some other animals, the *Gregarina gigantea* constitutes the largest known cell. — *The Academy.*

ANTHROPOLOGY.

Aboriginal Relic from Trenton, New Jersey. — In the "Proceedings of the Academy of Natural Sciences of Philadelphia," and in local papers, we have frequently called attention to various large deposits of arrowheads, axes, etc., and to interesting isolated specimens of curi-

ously shaped relics, found in and near this city. We now call attention to the relic figured here as one that is unique, at least so far as New Jersey is concerned. About four and a half inches long it is very accurately sloped to the back, which is a flat ridge, uniformly one-thirty-second of an inch in width, from the neck to the posterior end, which curving upward, is about double that thickness on the edge. The head of the stone is oval, accurately cut, with a width in the centre of three-sixteenths of an inch. The knob-like protuberances, stand out from the head one-third of an inch, and have a narrow neck, about one-half the width of the head of the protuberance, as seen in the illustration (Fig. 85). The bottom, as the drawing shows, is flat. At either end is a hole drilled; in the front the hole is about a quarter of an inch from the end and drilled obliquely, until it meets the drilling from the neck, which is bored at a similar angle to the neck, as the under one is to the base. The holes at the posterior end are similarly bored. The material is hornblend.

Fig. 85.

If the stone is meant for a representation of some animal the holes would seem to be intended for the insertion of legs; but probably were used to insert a string or sinew, that the figure might be carried about the neck. We have never seen any large collection of these "Indian" relics, and do not know whether it is a common form elsewhere or not, but, as we previously stated, it is novel to New Jersey. It was ploughed up near the city, in a neighborhood where only axes and arrow points are to be met with, and those not abundantly. — CHARLES C. ABBOTT, M.D.

ORIGIN OF THE TASMANIANS. — MR. Bonwick, in a recent paper "On the Origin of the Tasmanians, geologically considered," states that the Tasmanians have now become almost extinct, an old woman being the only survivor of the race. They were related in manners and in general *physique* to the neighboring Australians, but were allied by black skin and woolly hair to the distant Africans, while they were assimilated by resemblance of language, customs, and habits of thought, to many races scattered over vast areas. The author seeks to explain this relation by constructing an ideal southern continent, whence all the dark-colored races surrounding the Indian Ocean, and extending into the Pacific and southern oceans may have radiated. He regards the Tasmanian as probably older than the Australian. Dr. Hooker, whose authority had frequently been quoted in the paper, pointed out the similarity and differences that obtain between the floras of Australia, Tasmania, New Zealand, South Africa, etc. It has recently been found that the flora of the Howe Islands is very unlike that of Australia, although so near to the coast. He protested, however, against the inference that the line of migration followed

by plants is necessarily the same as that pursued by the higher animals. The president alluded to the great difference between the Australian and Tasmanian, especially in the character of the hair; and he regarded it as physically impossible that the Tasmanian could have come from Australia. He suggested that an interrupted communication by a chain of islands may have extended from New Caledonia to Tasmania, similar to that which now connects New Caledonia with New Guinea; and that by this means a low negrito type may have spread eastward over this area. — *Scientific Opinion.*

Stone Images on Easter Island. — A paper was read by Mr. J. L. Palmer, R. N., on a recent visit to Easter Island in H.M.S. *Topaz.* During the visit the singular colossal stone images which excited the astonishment of Captain Cook and the earlier voyagers were accurately observed and measured, and a specimen of them brought away to deposit in the British Museum. Mr. Palmer described the topography of this remote island in the South Pacific. It is only twelve miles in length by four in width, and lies in a part of the ocean far away from other islands, at a distance of two thousand miles from the coast of South America, and one thousand miles from the nearest Polynesian islands to the west. The island is entirely a volcanic formation, and presents numerous extinct craters, one of which yields the gray lava of which all the stone images are made, and another the red tufa from which are carved the crowns or hats that formerly rested on their heads. The present inhabitants are only nine hundred in number — a good-looking, pleasant-tempered, set of people. They belong to the Polynesian race, and have a tradition of their immigrating from Opara at no very distant period. The interest attaching to the island was an ethnological one, and concerned the race who sculptured the vast quantity of stone images now existing *in situ* on stone platforms in various parts of the island, or inside large stone chambers or houses. The platforms, chambers, sculptures, and mural paintings were described by the author with minuteness, but he did not propound any theory as to their origin. He stated that the inhabitants knew nothing of the matter, that they were undoubtedly of great antiquity, and that it was probable they were executed by a race who had long since passed away.

In the discussion which followed Mr. Markham mentioned the fact of similar images having been found by the early Spanish invaders in the cities on the banks of Lake Titicaca, in South Peru, and belonging to the Aymara nation. There existed, however, this difference — that the Aymara images were profusely sculptured. Recently a stone platform had been found in one of the Pacific Islands, one thousand miles to the west of Easter Island, at the bottom of a deep deposit of guano, and he threw out the suggestion that these were all relics of a very ancient people who slowly migrated across the Pacific from west to east. Mr. Franks gave in detail his reasons for concluding that the ancient remains

in Easter Island truly belonged to an earlier population of the same Polynesian race who now inhabit the island. Sir George Gray also expressed the same opinion, and spoke of the habit of carving images as being a peculiarity of Polynesians, including the Maories, and that in a place where wood (the usual material) was very scarce, as it is in Easter Island, it was natural that stone should be substituted. Mr. Palmer gave some farther details of the amiability and good conduct of the present inhabitants, who had been much improved by the Roman Catholic missionaries. Mr. P. P. Blyth also took part in the discussion, and the president, in summing up, mentioned the soft nature of the volcanic rock of which the images were made as supporting Sir George Gray's explanation. — *Scientific Opinion.*

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. — The meeting of the Association for 1870 will be held at Troy, N. Y., beginning on Wednesday, August 17th, having been postponed by the Standing Committee from the 3d, at the request of the Local Committee. We believe from the general expressions last year at Salem that this next meeting will be largely attended and will prove a most interesting one. The Local Committee is evidently doing all it can to make the meeting a success; and judging from the character of the gentlemen composing the Committee, its large size, and careful division into sub-committees on Receptions, Finance, Lodgings, Excursions, Rooms, Invitations, Printing and Railroads, we feel confident that the Association will be most cordially received and taken care of during the session.

We trust that the subsections of *Archæology* and *Ethnology*, and of *Microscopy*, organized at the Salem meeting, will be reorganized with a large attendance in these interesting departments.

The following are the Officers of the Meeting: — William Chauvenet, St. Louis, *President;* T. S. Hunt, Montreal, *Vice-President;* Joseph Lovering, Cambridge, *Permanent Secretary;* C. F. Hartt, Ithaca, *General Secretary;* A. L. Elwyn, Philadelphia, *Treasurer.*

Standing Committee.—William Chauvenet, T. S. Hunt, Joseph Lovering, C. F. Hartt, J. W. Foster, O. N. Rood, O. C. Marsh, A. L. Elwyn.

Local Committee. — John A. Griswold, *Chairman;* George C. Burdett, *First Vice-Chairman;* P. V. Hagner, *Second Vice-Chairman;* Benjamin H. Hall, *General Secretary;* H. B. Nason, *Corresponding Secretary;* Adam R. Smith, *Treasurer,* and seventy-seven others.

ANSWERS TO CORRESPONDENTS.

C. J. C. The plant found in flower June 21, on Mount Monadnok, is the *Arenaria Grœnlandica.* It is abundant on the summit of Mount Washington, and we have found it common at Hopedale, Labrador, where it grows near the shore of the ocean.

BOOKS RECEIVED.

Descriptions of New Corals. By A. E. Verrill. [From Am. Jour. Sci. and Arts. May, 1870.]

Reviews of Report on Invertebrata of Massachusetts, and of Molluscan Fauna of New Haven. By A. E. Verrill. [From Am. Jour. Sci. Arts. May, 1870.]

Valedictory Address, Jefferson Medical College. By J. A. Meigs, M. D. Philadelphia, 1870.

Ueber die Mikroskope Nordamerikas, von Dr. H. Hagen. Pamph., 8vo. 1870.

The Elevation of Mountains. By C. H. Hitchcock. 8vo, pamph. April, 1870.

Tidsskrift for Populære Fremstillinger af Naturvidenskaben. 1870. Kjobenhavn.

American Entomologist and Botanist. Vol. ii. Nos. 7-8. May, June, 1870.

New York State Library. Fifty-second Annual Report of Trustees.

Peabody Institute. Eighteenth Annual Report of Trustees. Peabody, 1870.

American Journal of Medical Sciences. No. 118. April, 1870. [Quarterly, $5.00.] Philad.

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MUD-LOVING FISHES.

BY CHARLES C. ABBOTT, M.D.

Fig. 86.

Melanura limi.

Much is lost to those who essay to study the habits of fresh-water fishes, first, by ignoring uninviting mud-holes, and secondly, by walking carelessly to the banks of the stream, and seeing nothing at first, think they are themselves unseen by anything inhabiting the water. Never was there a greater mistake! Nine times in ten, if these same streams be approached cautiously, and yourself concealed, you peer carefully into the water, you will find it tenanted by many and larger fishes, than you supposed were there. Following out this plan, we once saw and captured a chub (*Semotilus rhotheus*) thirteen inches long, in a narrow brook of but six inches in depth. This fish, when the bank was carelessly approached, would withdraw to a deserted muskrat burrow.

After standing quietly for a few minutes upon the bank of a stream that has been openly approached, one will notice

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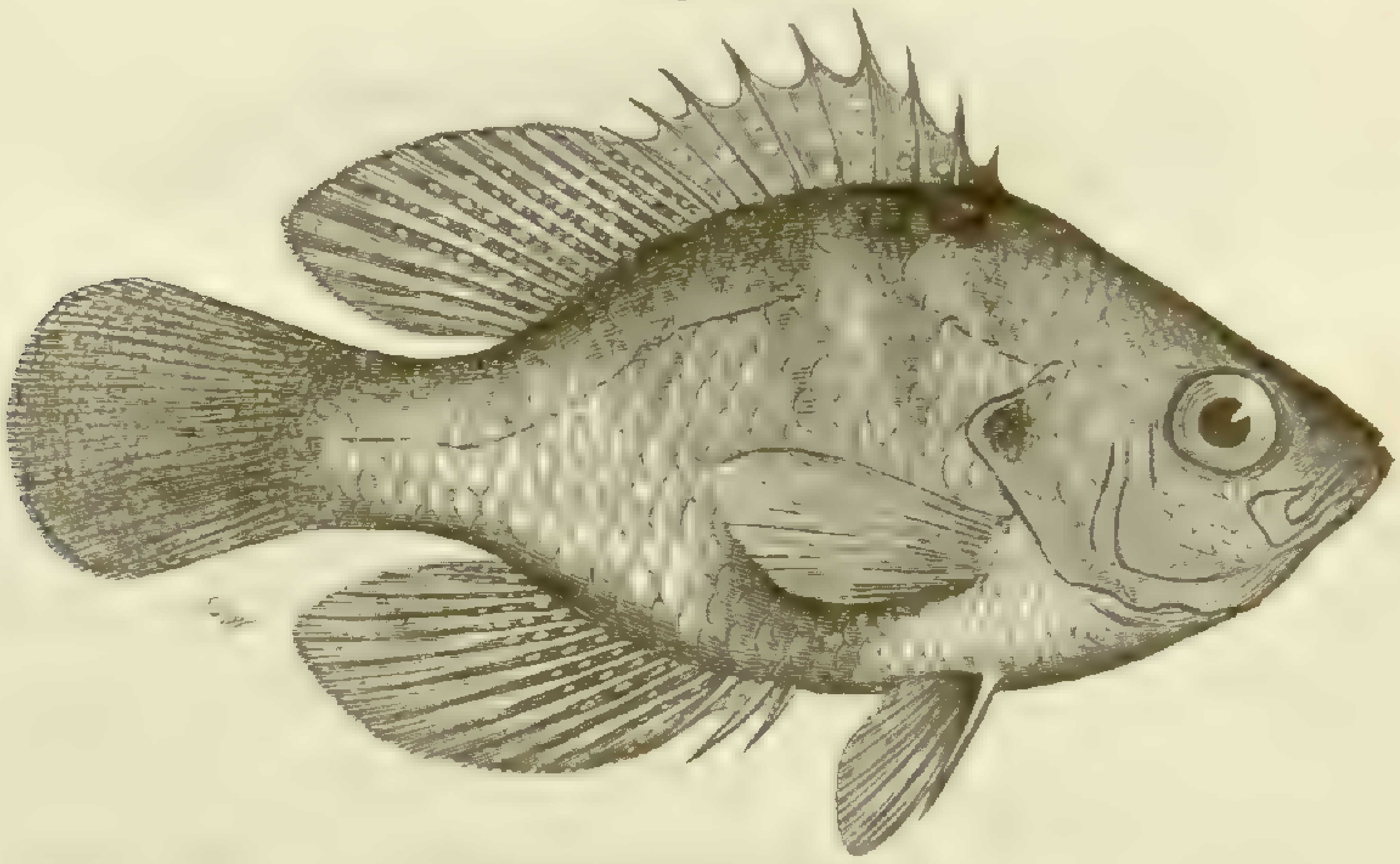
the gradual appearance of the fishes your sudden presence startled and sent off; but returning under such circumstances they are not the same fish in their movements; for although *they may appear to swim about fearlessly*, they nevertheless are watching you, and fail to exhibit many of their peculiar habits. An aquarium, even, in which fishes become tame, is best watched at a distance, as more is going on generally, than when you are near by. Fish are like children, fuller of mischief when alone. These remarks, be it understood, apply to some species—not all. What we design considering as mud-loving species are nine in number, all common to the Delaware and its tributaries, at and near Trenton,

Fig. 87.



Enneacanthus guttatus.

New Jersey. They are the Spotted Sun-fish (*Enneacanthus guttatus*,* the Mud Sun-fish (*Acantharcus pomotis*), the Mud Minnow (*Melanura limi*), Mud Pike (*Esox porosus*), Mullet (*Moxostoma oblongum*), Black Sucker, *Catostomus* (*Hylomyzon*) *nigricans*, Mud Cat-fish (*Amiurus DeKayi*), Eel (*Anguilla tenuirostris*), and the Lamprey (*Petromyzon nigricans*). (We consider the *Ichthyomyzon appendix* as the young of the last, or an allied *Petromyzon*).

Spotted Sun-fish (*Enneacanthus guttatus*). We have very

* We trust the nomenclature of our fishes is finally established; and no species will be farther burdened with confusing synonomy. We follow Cope (Journal Acad. Nat. Sci., Phil., Vol. vi, part 3, p. 216, Jan., 1869), in this paper; and if farther changes are proposed, feel now as though we should adopt them with reluctance.

carefully searched for a trait characteristic of this fish as compared with *E. obesus*, and have uniformly failed to do so. The habits of the species are those of the Centrarchidæ generally, modified in so far as being merely more of a mud-loving species. So purely a mud-dwelling fish are they that we have frequently found them in water so shallow, that they marked the mud with their pectoral fins in swimming; preferring such shallow water, with the mud, to that which was deeper, to which they had access, because it was over a stony bed. In winter they congregate in deep water, and unless care is taken to dig well into the mud they will not be taken in the ordinary scoop-net. We found, during the past winter, in one instance, that a large number had *apparently* scooped out a basin in the bottom of a little pond. At any rate, closely huddled together, in a small space, somewhat deeper than the surrounding bed of the pond, was a large number. Examination of several showed they were then taking no food. The stomach of each specimen, and the whole digestive tract, in fact, were empty.

The main interest attaching to this species, at least to us, is the fact of its occupying many small, sluggish streams, similar and side by side with others that harbor, though less abundantly, the *E. obesus*. We never yet have found them associated in small streams, in the tributaries of the river; yet, in the Delaware itself the *E. obesus* is occasionally, and the *guttatus* frequently found. North-east of Trenton, in the Spar-kill, a creek emptying into the Hudson, and in the streams along the coast, emptying into the bays, the *E. obesus* abounds; and the *guttatus* has not been found. Along the Delaware both are found, the *guttatus* more abundantly. Professor Cope has found *E. guttatus* near Richmond, Virginia, and (verbal communication) has not found it about Philadelphia. It is undoubtedly in the Delaware, at Trenton —distance thirty-seven miles. We have been thus particular in stating its habitat, because the fact of its not associating with the *E. obesus* is a mystery we cannot explain,

except in the manner following. The similarity of these two Enneacanthi is so marked, that unless living, they can scarcely be distinguished; and considering the abundance of one and presence of the other, but not associated, we suggest that the *E. obesus* is with us, not of its own choice, but forcibly brought by freshets from the localities where it is the only Enneacanth (New York State) to this, the proper territory of the *E. guttatus*. Once here it occupies certain streams from which it has driven the former occupant, *E. guttatus*. It is always found in the streams having unobstructed access to the river. If this be a true explanation of its presence does it not confirm its claim to a distinct specific title? In the "Geology of New Jersey" we confounded the two species, considering *Pomotis guttatus* Morris, a synonym of *Bryttus obesus* Girard.

On the 16th of March we found females of the Mud Minnow (*Melanura limi*), in clear, cold, running water. They were much distended with large masses of orange-colored eggs, that we should judge were nearly "ripe." We have watched them frequently since but failed to find them depositing these ova. At this time, April 19, a large proportion of the females are no longer gravid. It would appear that in March they were passing up stream, or brook, to spawn, but appeared to be unaccompanied by males.

We have lately found that this fish, when grown, feeds largely upon small shells (*Physa* and *Lymnæa*). We have seen them seize the animal, crush and then drop the shell, and then, by nibbling at the extruded soft parts, finally succeed in devouring all but the shell. Young crawfish are also worried to death by this cyprinodont, which at first bites off the larger claws, and ultimately succeeds in crushing the whole shell. On the other hand they are themselves exposed to attacks from a voracious animal, which takes advantage of their lying buried in the mud. We refer to the odoriferous Cinosternoid (*Ozotheca odorata*). This turtle appears to be able to discover the whereabouts of the mud-

minnows without alarming them; and cautiously approaching from behind, they seize the head of the fish that is scarcely extruded from the mud. This they generally completely sever from the body, cast aside, and then draw from the mud the decapitated body. We doubt the ability of this turtle to catch a mud-minnow not concealed *in* the mud. When lying *on* the mud, like an Etheostomoid, their movements are very rapid when disturbed.

In speaking of the habits of certain species of fishes as "mud-loving," or dwellers in and upon mud, we really indicate merely those species that are most truly nocturnal. We judge that, to a certain extent, all fish are nocturnal. We have often noticed that fish will leap from an aquarium, if uncovered during the night; but this occurs but seldom during the day. Fishing with a line has always been more fruitful with us at night than fishing during the day; even when fishing for yellow or white perch, and other active day fish. Nets set over night entrap a greater number, and larger specimens, than when set for the same number of hours between sunrise and sunset.

These remarks are peculiarly applicable to the two Catostomoids we have mentioned above, *Moxostoma oblongum* and *Hylomyzon nigricans*. Unless quite small, less than six inches in length, these "suckers" remain quiet throughout the day; but as night approaches they leave the shallow, muddier portions of the creeks, and swim towards and into the deeper waters. About sunset we have often noticed them coming to the surface, and with their nostrils above the water, they make a low, sibilant sound, and leave in their wake a long line of minute bubbles. When attacked, as they frequently are at this time, by turtles, they give a very audible grunt, similar to that of our chub when drawn from the water. Both of these "suckers" are occasionally found, even during the day, in running water, hunting among the stones upon the bottom; but still water and soft mud are never far distant. The "suckers" of our rivers are very

different in *their* likes and dislikes. Coming up the stream in February and March, the large-scaled species, *Teretulus macrolepidotus*, and the common *Catostomus Bostoniensis*, seek out rapid waters, rocky bottoms, and are so active and fearless during the day, that many are seen and killed in the shallow waters they have entered. This is very noticeably the case at Trenton, New Jersey, where the Assunpink creek enters the Delaware. The "suckers" come up to the foot of the dam and congregate there in large numbers. Both of these species bite readily at a hook; but the "mullet" and "black-sucker" never do with us.

We can imagine nothing more devoid of interest than a mud-catfish (*Amiurus DeKayi*), at least as we have them here in New Jersey. Occasionally one of unusual size is met with to give it some characteristic worthy of attention. The largest specimen we have ever seen weighed five pounds, thirteen ounces. The greatest width of the head was five and one half inches. This species wallows in the mud in the beds of streams of all sizes; it is abundant in many of our largest creeks, in every mill-pond, and in average sized ditches with overhanging banks, this "mud-lover" frequently congregates in large numbers. It is a little curious to notice how soon matters right themselves, as to the distribution of fishes, after a freshet has subsided which had obliterated the previous boundaries. We have in mind now an extensive tract of meadow, through which meanders two rapid current creeks, and also through it are cut innumerable ditches. In these ditches dwell several mud-loving fish. Of course the freshet produces considerable of a "scatter" among them; but on the subsidence of the water we very seldom find mud cat-fish in the clear-water creeks, and the running water species caught napping in the ditches very promptly leave, as a few days suffice to restore to each locality its characteristic species.

In our report in the "Geology of New Jersey," we gave but three fresh-water siluroids. Since then we have had our

attention called to the stone cat-fish (*Noturus gyrinus*), from the Delaware Water Gap, Warren County, New Jersey. Besides the specimens from this locality in the Museum of the Philadelphia Academy we have seen one living specimen in an aquarium, taken in the Assunpink Creek at its mouth. This is the only living specimen taken in New Jersey that we have ever seen, but learn that it is common in some of the rocky creeks in the northern part of the State.

The Eel (*Anguilla tenuirostris*), as elsewhere we suppose, is abundant in all our water courses. A careful examination of specimens from various localities, and comparison of reports of local fishermen, tend to the fact (?) that the largest eels are to be found in the rivers and streams directly tributary to them; and that in isolated mill-ponds far distant from the main water courses, they are not so large or numerous. We do not admit that such is really the case, but it does *appear to be true.* The experience of other observers would be interesting to know; and how large do our various species of *Anguilla* grow, as found in fresh-water? In the Delaware and its many small tributaries we find the Lamprey (*Petromyzon nigricans*) very abundant. Although occasionally found sticking to the sides of large fish, shad, rock-fish, white-perch and chub, they do not appear to feed upon fish thus exclusively. We have frequently found a large quantity of them adhering to the carcasses of dogs and other drowned animals, and judge that they subsist upon dead, rather than living animal matter. In an aquarium they adhere to the glass sides and *remove* the green scum very effectually, but whether they devour it or not we could not ascertain. We have known the Lampreys to *suck* their way up the facing of mill dams and so wander far up from the river. In such cases they bury themselves in the mud, in the winter, as do eels instead of following the river out into the sea.

VARIATIONS IN NATURE.

BY THOMAS MEEHAN.

THE idea that art has made most of the variations we find in gardens is far removed from the truth. It has done much to prevent a true knowledge of the origin of species. Art has done little towards making variations; it has only helped to preserve the natural evolutions of form from being crowded out. There is scarcely any species of wild plants but will furnish numberless variations, if we only look for them. To-day I examined a large patch of ox-eye daisies (*Chrysanthemum leucanthemum*). The first impression is that they are remarkably uniform, yet there were some with petals as long only as the width of the disk; others with petals double the length. In some the petals taper to a narrow point; in others they are tridentate on the apex. Again, some flowers have petals uniformly linear. Others have them tapering at both ends. Some have recurved and others flat petals. In one plant the *scales of the involucre were very much reflexed*, a very striking difference from the usually closely appressed condition.

I have frequently found that these very common things which nobody looks at, furnish as many new facts to an enquiring mind, as the rare species which every one loves to see.

OBSERVATIONS ON THE FAUNA OF THE SOUTHERN ALLEGHANIES.

BY PROFESSOR E. D. COPE.

I. On the so-called Alleghanian Fauna in General. The terms Canadian and Alleghanian, have been applied by Pro-

fessors Verrill* and Agassiz† to faunal associations of species of animals, characteristic of Canada and adjacent territory, and the Middle and Eastern United States, etc. The former author, in the later essay quoted, attempts to define these faunæ in a more or less precise manner, regarding the southern boundary of the first as "coincident with a line which shall indicate a mean temperature of 50° Fahrenheit, and the southern boundary of the second, to be the line of 55°." In accordance with this view the southern boundary of the Canadian fauna, commencing at the mouth of the Penobscot River in Maine, extends parallel with the coast into New Brunswick, and returning through middle Maine passes south of Moosehead Lake and the White Mountains, along the eastern base of the Green Mountains to the south, and up their western foot to the river St. Lawrence. From near Montreal it turns to the south-west, and, passing through Lake Ontario, crosses Michigan from St. Clair to Milwaukee, and rises following the valley of the Mississippi northwards. The Adirondack Mountains were regarded as a portion of this fauna, surrounded, like an island, by the Alleghanian.

The southern boundary of the Alleghanian was traced from near Norfolk, Virginia, up the valley of the James River to the Alleghany Mountains, southward along their base to their termination in Georgia, and then north again along their western slope to Kentucky and the Ohio River. The Southern, or Louisianian, fauna included the lower portion of the Ohio basin, and an undetermined extent of that of the Mississippi north of the latter. The boundary line then descended to the south to the west of that river. I may suggest here that the most northern habitat of the *Siren lacertina* might prove to be near the northern extreme of the boundary in question. This point, so far as I am aware, is

* Proceedings Essex Institute, III. 136. Proceedings Boston Society of Natural History, 1866, 260.

† Nott and Gliddon, "Types of Mankind," 1853.

Alton, Illinois, from which place I have a specimen of that species.

My object at present is to show that the region, including the crest of the Alleghany Mountains to their southern extremity in Georgia, possesses a fauna in many respects entirely different from that of the southern two-thirds of the Alleghanian fauna as defined by Verrill, and in some respects as similar to the Canadian. My conclusions are based more on observations on the distribution of birds than on animals of other classes, as were also those of Professor Verrill. They are very imperfect, and I have no doubt that additional observations will increase the weight of evidence in the direction here pointed out.

Among Mammalia three species may be noticed, namely: *Sciurus Hudsonius*, *Cervus Canadensis*, *Lynx Canadensis*. The first named species is characteristically northern, and little known in the southern part of the above defined Alleghanian fauna. In southern and eastern Virginia it is unknown, as well as in North Carolina and Tennessee. It is, however, not uncommon on the summits and crests of the Alleghanies in both the former states. In North Carolina and southern Virginia it is so restricted to the heights as not even to descend into the mountain valleys. I resided for nearly two months at the Warm Springs, Madison county, North Carolina, and in Henderson county, in the same state, at an elevation of two thousand five hundred feet above the sea, without observing a single individual; yet the inhabitants are well acquainted with them as game of the mountain tops, under the name of the "Mountain Boomer," a name they bear in Virginia, also. This distribution and name are mentioned by Audubon and Bachman in their great work.

The elk is recorded by Baird as having left remains, during human habitation, in West Virginia. Of this fact I was also assured when in the same region. Dr. Hardy, of Asheville, North Carolina, states that horns of the elk were found in

the woods on the Black Mountains at that southern point, when he was younger, and that he is satisfied that its range extended nearly to South Carolina during the human period. This species formerly ranged over the Alleghanian fauna, but is now nearly confined to the Canadian.

Like the red squirrel the Canada lynx extends to the southern limits of the Alleghany ranges, occupying the highest ground, though apparently not so restricted to the elevations as the first named. It is distinguished, by the name catamount, from the *Lynx rufus* which is called wild cat, and is well known to the hunters. It is known to be a northern species, being unknown in the wilds of the lower country of Virginia and North Carolina, where the *L. rufus* takes its place. What its southern limit is, in eastern and western Pennsylvania, I am unable to ascertain.

In Giles County, E. Virginia, at an elevation of five thousand feet, I observed in August, 1867, the following species of birds: *Junco hyemalis*, *Dendrœca icterocephala*, *D. Blackburniæ*, *D. cœrulescens*, *D. maculosa*, *D. virens*, *Myiodioctes Canadensis*, *M. mitralus*, *Parula Americana*, *Mniotilta varia*, *Setophaga ruticilla*. From the season at which these were observed, they evidently bred in the locality in question. They were most of them abundant.

In the high valley of Henderson county, and on the Black, Rich, and other mountains in southern North Carolina in September, 1869, I observed the following: *Junco hyemalis*, *Vireo solitarius*, *Dendrœca coronata*, *D. maculosa*, *D. virens*, *D. cœrulescens*, *D. Blackburniæ*, *Parula Americana*, *Mniotilta varia*, *Myiodioctes mitratus*, *Setophaga ruticilla*. These were also abundant, and no doubt bred in the localities in question.

These species are enumerated as especially northern forms. They pass Philadelphia in latitude 40° in early spring (April and May), on their way to northern breeding places. Rarely a *Setophaga ruticilla* breeds in that region, but the great majority accompany the northern Dendrœcas and the

Vireo solitarius. Of the list, Verrill states that *Mniotilta varia*, *Parula Americana*, *Dendrœca virens*, *D. Blackburniæ*, *D. icterocephala*, *Myiodioctes Canadensis*, *Setophaga ruticilla* and *Vireo solitarius*, breed at Norway, Maine, at the northern limit of the Alleghanian fauna. *Dendrœca coronata* and *Junco hyemalis* migrate still farther north to within the limits of the Canadian fauna, to breed: *D. maculosa*, not breeding at Norway, may have similar habits. The two former birds are regarded by Verrill as true types of the Canadian fauna, the *Junco* representing in part *Spizella socialis* of the Alleghanian, and the *D. coronata* the *D. pinus* of the same.

The southern localities now given for the species of the two lists, I have not found recorded, except in the case of *Junco hyemalis*, which according to Audubon breeds in the Virginian Alleghanies. The species mostly, and especially the last named, are confined like the red squirrel to the most elevated mountain crests. In North Carolina these range from five thousand to six thousand seven hundred and forty feet.

It is also evident that a number of species of birds, mostly wood-warblers (*Dendrœca* and other *Tanagridæ*) have an east and west, as well as north and south migration; passing to and from the Alleghany Mountains, instead of going to the New England States and Canada.

Among the Batrachia a single species is found on the high peaks of the Black Mountains, and its faunal relations are similar to the preceding. This is a species of Salamander, the *Desmognathus ochrophæa*, which is common in that Canadian island, the Adirondack Mountains, and in the Alleghanies as far south as the South of Pennsylvania. In the lower country of New England and New York it appears not to be known to naturalists, though it may occur there, while in Southern Pennsylvania it is not found. Its range extends to the Georgian Alleghanies, as a specimen similar to those from the Black Mountains was sent to the Smithsonian Institution by Dr. Jones.

The preceding species of mammals, birds, and batrachia, accompany very exactly the range of the trout (*Salmo fontinalis*). This well known fish is already in South-western Virginia, confined to the most elevated peaks and knobs, and does not even occur in the streams of many of the mountain valleys. In North Carolina its distribution is quite similar. I took it in the headwaters of the French Broad, and was satisfied that it occurs in the head of the Catawba. Dr. Hardy, of Asheville, who is very familiar with the Southern Alleghany Region, assured me that it is found in the headwaters of the Chattahoochie in Georgia, the only example of its occurrence in a river flowing directly into the Gulf of Mexico, with which I am acquainted. At the same time Dr. Peck of Mossy Creek, Tennessee, who has fished for trout in most of the Alleghany streams, is of the opinion that the fish does not occur in any streams in the Cumberland Mountains.

The wood frog (*Rana sylvatica*) also occurs on the mountains of North Carolina, but what the southern limit of its range in the low lands is, I do not know.

Of the eighteen species above enumerated, at least ten are not found in the southern half or more of the Alleghanian fauna, that is, are not known as residents about Philadelphia, and most of them are not found within a considerable distance north of that point. Of this number at least two belong exclusively to the Canadian fauna, while of the remaining eight, five (*Lynx Canadensis*, *Sciurus Hudsonius*,* *Cervus Canadensis*, *Setophaga ruticilla* and *Salmo fontinalis*), are absent or rare in the low countries south of Philadelphia.

The value of the isothermal of 65° during April, May and June, as a boundary of faunæ may thus be questioned, though it is probably as determinative as any other that

* A friend long resident in Loudon Co., Va. (on the Potomac), informs me that the red squirrel does not occur there. Prof. Baird gives in the 8th Vol., U. S. Pac. R. R. Rep't, measurements of specimens from Mississippi.

could be fixed upon. Thus the limit of the breeding region of the ten northern species above alluded to might be regarded as such a boundary. This would be about the parallel of the mouth of the Connecticut (or Hudson), and it would coincide with the northern limit of several genera and species of fishes. Thus Lepidosteus, Clinostomus, Enneacanthus, Acantharchus and Carpiodes, do not exist north of this point, nor the widely distributed species *Semotilus corporalis* and *Hypsilepis analostanus*. There is, however, nearly as much change at the latitude of the Susquehanna, while at the James, Micropterus, and probably Campostoma, have their northern Atlantic limit.*

II. On the fauna of the Upper Valley of the French Broad River, North Carolina.—This valley is probably the most extensive for its elevation above the sea, in the Appalachian region. It may be said to extend from near Asheville at the southern extremity of the Black Mountains, to near the line of South Carolina, or the Saluda Mountains, north and south. On the east and west it is bounded by the Blue Ridge and the Cold Spring and other ranges, respectively, embracing the counties of Henderson and Transylvania and part of Buncombe. The French Broad River traverses it from south to north, taking its rise in the southern and western bounding mountain ranges. This fine valley is comparatively level, and the soil, though loamy, contains a considerable proportion of sand. The river pursues a level course with but few rapids, and through broad meadows susceptible of high cultivation. The climate is delightfully equable, being without summer heats and winter snows. The magnificent scenery, in views of the surrounding mountains, especially to the westward, have made it the Saratoga of Charleston and Mobile; and its claims,

*In an essay on the distribution of fishes in the Alleghanies of South-western Virginia, I stated, p. 245, that Amblodon does not occur in the Lake district. I have since ascertained, through Professor Agassiz, that it is found in Lake Champlain.

so superior in scenery to that watering place, will no doubt be some day recognized by the citizens of our northern cities.

According to the measurement given by Prof. Kerr, in his first report on the progress of the Geological Survey of the State, the elevation of this valley is twenty-five hundred feet above the sea. The highest point in the great valley of the Alleghanies, on the line of the Virginia and Tennessee Railroad in south-west Virginia, is nineteen hundred feet, according to the railroad surveys. The Black Mountains rise from the Upper French Broad Valley to six thousand seven hundred and forty feet. On the south, three ranges separate it from the upper country of South Carolina, the southern escarpment of each of which presents a much greater descent than the northern.

As might have been expected, the products of this valley approximate, in some respects, those of the North. It is the source of supply for the immediately adjoining southern regions, of apples, potatoes, and cabbages that will head. In its fauna it partakes of a few northern traits. I observed the following birds there in September, so that I cannot be sure that they breed there, or that they had not descended from the surrounding mountains: *Mniotilta varia*, *Parula Americana*, *Dendrœca virens*, *D. cœrulescens*, *D. maculosa*, *Setophaga ruticilla*. The reptile fauna presented on the other hand a marked peculiarity, and I write the present notice to call attention to it. The lizard *Oligosoma laterale* Say, was common; the salamander *Spelerpes guttolineatus* was excessively abundant, and a single example of *Amblystoma talpoideum* was found there under a log, during my residence of a week. These three species have been looked upon as representing our extreme southern Reptile fauna. They have not been found hitherto north of the low country of the Gulf States, and its prolongation up the low valley of the Mississippi. The *Amblystoma* only, of the three, has occurred near Cairo, Ill. (Mus. Smithsonian). The *Speler-*

pes guttolineatus seemed to take the place in habit and manners of our *Plethodon erythronotus*, which did not occur there. The occurrence of these species at that elevation seems quite peculiar, as I did not meet with either of them in three weeks in the valley of Tennessee from ten to thirty miles north of Knoxville, nor in two months in the low country of western, middle and eastern North Carolina, in the latitude of this valley.

Besides these species, there were abundant the widely distributed *Spelerpes bilineatus*, *S. ruber*, *Amblystoma punctatum*, and *Desmognathus fuscus*. *D. niger* and *D. ochrophæus* of the neighboring mountains were not there.

As to the flora of the valley I made but few observations. The buckeyes and Gordonia of the Cumberland Mountains had disappeared, and the universal "stick-weed" (*Actinomeris squamosa*) of the Great Valley was rare. *Aconitum uncinatum* adorned the thickets with its twining stem bearing large blue flowers. The coarse *Silphium terebinthaceum* was conspicuous in the old fields, along with abundance of a common *Cratægus*. In the woods there were three species of *Viburnum*, and the swamps were often well protected against intruders by the *Smilax laurifolia*. The moss supported abundance of the *Sarracenia purpurea*, and a second species, perhaps *S. rubra*.

The latter plant is interesting as furnishing another instance of the dependence between species of different kingdoms, for means of subsistence. The tubular leaves of this species are erect and slender, or trumpet shaped. The delicate hairs with which they are lined increase in coarseness to near the base, while they are so delicate on the inside of the free portion of the leaf as to produce the effect of iridescence. Insects which enter are imprisoned by this arrangement, and I did not examine a specimen, of the many observed, which did not contain at least an inch of dead insects of all orders, in the bottom. On the top of this mass of decay a large dipterous larva was invariably found.

It was not of a kind familiar to me, and seemed evidently to depend for subsistence on the animal matter furnished by the trap-like qualities of the *Sarracenia* leaf. I did not observe any such tenant in the *S. purpurea*, where the hollow petioles were frequently more or less filled with water.

III. On some species of Spelerpes. — In his original descriptions of North American Salamanders, published many years ago by Professor Jacob Green, he mentioned one under the name of *Spelerpes cirrigera*, which was said to have been discovered in Louisiana. This animal was small, and furnished with a marked peculiarity in the shape of a dermal appendage or tentacle, dependent from the upper lip near the nostril. In other respects the animal was allied to the *Sp. bilineatus*, the small species so generally distributed over the United States. In Holbrook's extensive work on herpetology, this species is again described and figured, but no new specimens are mentioned as having been discovered, and it is regarded as very rare. In 1869 the writer made a study of the North American salamanders preserved in the Museum of the Smithsonian Institution, and examined with much interest, among others the types of Green's description of *Spelerpes cirrigera* from Louisiana. A narrow investigation of these convinced me that no other character existed by which to distinguish them from a usual southern variety of *Sp. bilineatus*, than the two peculiar cirri originally observed by Green. Now these cirri are evidently remnants of an early larval character universal among tailed Batrachia, namely, the balancers. These are a long process on each side of the head immediately in front of the branchial processes, which appear very early, indeed almost simultaneously with the latter. They are probably homologous with the beards of the larval Dactylethra of Africa described by Wyman and Gray, which give those tadpoles so much the appearance of Siluroids, or cat-fish. In our salamanders they disappear at various periods of growth, and sometimes leave

traces in the form of an angle or swelling beneath the nostril on the lip, and sometimes as in the supposed species *Spelerpes cirrigera*, as a tentacle, or cirrus. Influenced by this consideration I referred Green's salamanders to his *Sp. bilineatus*.*

In the course of collecting in the Alleghany region of Tennessee and North Carolina, I became satisfied of the propriety of this step. While in the recesses of a cave in the valley of Tennessee, in Jefferson county, I found a very fine specimen of *Spelerpes longicauda* of a red orange color, which had well developed tentacles on each side, precisely as in the cirriferous *Sp. bilineata* of Green. Subsequently in ascending the Black Mountains in Buncombe county, North Carolina, I found five specimens of the typical form of *Sp. bilineata*, of which three were tentaculate, and two were not. Finally, in a considerable number of the *Sp. guttolineata*, from the headwaters of the French Broad in North Carolina, one presented the same feature of well developed tentacles.

This irregular preservation of a larval character, is of interest in connection with the theory of evolution. Should the presence of these tentacles be permanent in any species, it is not to be doubted that the character would be regarded as generic, and justly so. Its history would in that case be like the history of *all other* generic characters as representing the undeveloped stage of another type, if not itself the *ne plus ultra*. Should it be constant in a color variety only of some species, and wanting in other varieties, and in other species, the first would become the type of another genus, whatever its claims to specific distinction might be. The latter would of course follow the former! If, however, the naturalist of the old school had any suspicion that the two forms may have had a common origin, he would ignore the distinctions. The proper course appears to me to recognize characters as definitive when they are *constant*, and discuss their history afterwards.

* See Proceedings of the Academy of Natural Sciences, 1869. p. 107.

ON THE DEEP-WATER FAUNA OF LAKE MICHIGAN.

BY DR. WILLIAM STIMPSON.

A knowledge of the character of the animals and plants living at the bottom of the great North American Lakes, the largest bodies of fresh-water in the world, has long been a desideratum; and dredging operations have this year been initiated by the Chicago Academy of Sciences which have already produced interesting results. The first dredgings were made off Chicago, where the waters were found to be shallow, and the bottom sandy or gravelly. At a distance of eighteen miles from land the depth was but fourteen fathoms. The bottom was nearly barren of life. We obtained, however, specimens of the larva of some neuropterous insect, a *Clepsine*, a flesh-colored leech belonging to a new genus; a *Lymnæa*, two Melanians and a *Plumatella*. The plants consisted of a moss, a *Chara*, a *Nostoc*, and one other alga.

The next investigations were made in the more central and deeper parts of the lake. Dr. Hoy of Racine had been for some time endeavoring to ascertain the nature of the food of the whitefish, which had previously remained entirely unknown. These fish being caught in gill-nets and "pounds," are generally taken from the water some hours after being actually entrapped, and the food in the stomach becomes thoroughly digested, and its character undistinguishable before it can be obtained and examined. Dr. Hoy, however, after long search, succeeded in obtaining some fish in which the contents of the stomach was in a comparatively fresh state, and ascertained it to consist mainly of remains of small crustaceans. These he submitted to me for examination, and among them I had the pleasure of detecting indications of the existence of marine forms in the lake.

It thus became highly desirable to examine the ground upon which Dr. Hoy's fishes had been obtained, and accord-

ingly on the 24th of June last we started out from Racine for the purpose in a tug belonging to that place. The party consisted of Dr. Lapham, Dr. Hoy, Mr. Blatchford and Dr. Andrews of Chicago, and myself. We dredged at various points from twelve to twenty-six miles from land, the greatest depth found being sixty-four fathoms, with a bottom of blackish impalpable mud. Between the distances of twelve and twenty-two miles from shore the depth was tolerably uniform, averaging forty-five fathoms, the bottom being generally a reddish or brownish, sandy mud. On this plateau we obtained alive the crustacea found by Dr. Hoy in the stomachs of the whitefish, consisting of a *Mysis* and two species of *Gammarus*. A small white *Planaria*, and a new species of *Pisidium* also occurred. All of these animals were found in abundance, showing this portion of the lake bottom to be rather densely inhabited.

Mysis is a marine genus, many species of which occur in the colder parts of the North Atlantic and in the Arctic seas. One species, *M. relicta*, was found by Lovén in company with *Idothea entomon* and other marine crustacea in the deep fresh-water lakes, Wenner and Wetter of Sweden, indicating that these basins were formerly filled with salt-water, and have been isolated from the sea by the elevatory movement of the Skandinavian peninsula which is still going on. That the same thing has occurred to our own lakes is shown by the occurrence in their depths of the genus *Mysis*, notwithstanding the non-occurrence of marine shells in the quaternary deposits on their shores. Kingston on Lake Ontario, is, I believe, the highest point in the valley at which such shells have been found. Very probably, at the time when the sea had access to these basins, the communication was somewhat narrow and deep, and the influx of fresh-water from the surrounding country was sufficient to occupy entirely the upper stratum, while the heavier sea-water remained at the bottom. After the basins had become separated from the ocean by the rise of the land, the bottom

water must have become fresh by diffusion very slowly to allow of the gradual adaptation of the crustaceans to the change of element. Possibly the occurrence at the bottom of salt springs like those of the adjacent shores of Michigan may have had something to do with the slowness of the change. At present the bottom water, judging from a specimen we obtained from a depth of fifty fathoms approximately, is entirely fresh.

I am informed by Professor Gill that the *Triglopsis Thompsonii* of Girard is a marine rather than a fresh-water form. This fish inhabits the depths of the lakes, having been found by Professor Baird in the stomach of *Lota maculosa*, taken in Lake Ontario, and recently by Dr. Hoy in those of trout caught off Racine.

Our *Mysis* is allied to certain arctic forms, which would lead us to refer its original entry into the lakes to the cold period of the quaternary epoch. While the marine species usually live near the surface of the water, this one appears to be confined to the bottom, a result of its seeking the colder and at a former period the more saline waters.

The investigation of the materials obtained by the dredging parties of the Academy is now in progress, and the results will be published in full with illustrations at an early period.

CLIMBING PLANTS.

BY PROF. W. J. BEAL.

THE following remarks upon this interesting subject, can scarcely be called a review, but more properly a summary given nearly in the words of the author.* It has been made

* On the Movements and Habits of Climbing Plants. By Charles Darwin, Esq., F.R.S., F.L.S., etc. [From the Journal of the Linnæan Society.] pp. 118. London, 1865.

quite full, as it is likely the original paper has been read by but few readers of the NATURALIST.

Climbing plants may be divided into those which spirally twine round a support; those which ascend by the movement of the foot-stalks or tips of their leaves; those which ascend by true tendrils; those which are furnished with hooks, and those which are furnished with rootlets. The last two exhibit no special movements and are of less interest than the first three.

Spirally Twining Plants.—I begin with a special case, one depending upon my own observation, similar to the one taken by Mr. Darwin. A thrifty hop-vine in my yard went up nine or ten feet to the top of a stake. Still aspiring it ran above the support, at the same time reaching off and swinging round and round following the course of the sun. When about two feet above the stake the tip of the vine circumscribed a circle two feet in diameter. While it grew longer the extent of the circle was about the same, as a part of the vine had become strong and remained nearly stationary. By observations made at different times in the day it was found to perform one revolution in from one to two hours, moving most rapidly in the warmest part of the warmest days. It is now four feet and two inches above any artificial support, and has just tipped over to the north-east in the direction of the prevailing wind. The revolving movement lasts as long as the plant continues to grow, but each separate joint or internode, as it grows old, ceases to move. In the case of the hop and most other twining plants, about three internodes at a time partake of the motion.

The *Hoya carnosa* (*Asclepiadaceæ*) revolves opposite to the sun in five or six hours, making a circle of over five feet in diameter. The tip traced thirty-two inches per hour. It was an interesting spectacle to watch the long shoot sweeping night and day this grand circle in search of some object round which to twine. Sometimes it described nar-

row ellipses. After performing thirty-seven revolutions the stem of a hop was found to be twisted three times round its own axis in the direction of the sun. To prove that the twisting of the stem does not cause the revolutions, as Hugo von Mohl supposed, *some* stems are not regularly twisted and *others* twist in an opposite direction to the revolving plant. In many twining plants the end of the shoot is hooked so as the more readily to hold fast to any object of support which may be caught. This support once found, the point of contact ceases to move, but the tip continues to twine above and around the support as a rope swung around a stick will coil in the direction of the swinging rope.

If a stick shortly after having been wound round be withdrawn, the shoot retains for a time its spiral form, then straightens itself and again begins to revolve. Mohl believed that plants twined because of a dull irritability of the stem, but experiments prove that this is not generally the case.

If the support of a twiner be not lofty it falls to the ground, and resting there the extremity rises again. Sometimes several flexible shoots twine together into a cable and thus support each other. Single thin shoots will fall and turn abruptly back and wind upwards on themselves. The majority of twiners move in a course opposed to that of the sun or the hands of a watch. Rarely plants of the same order twine in opposite directions, but no instance is known of two species of the same genus twining in opposite directions. Of seventeen plants of *Loasa aurantiaca*, eight revolved in opposition to the sun and ascended from left to right, five followed the sun and ascended from right to left, and four revolved and twined first in one direction, and then reversed their course. One of these four plants made seven spiral turns from right to left, and five turns from left to right. Climbers of the temperate zone will not generally twine around thick trees, while those of the tropics can. Unless this were the case those of the tropics could hardly

ever reach the light. In our temperate countries twiners which die down every year would gain nothing as they could not reach the summit in a single season. With most twining plants all the branches, however many there may be, go on revolving together; but, according to Mohl, the main stem of *Tamus elephantipes* does not twine — only the branches. On the other hand, with the asparagus, given in the table, the leading shoot alone, and not the branches, revolved and twined. Some produce shoots of two sorts, one of which twines; the others not. In others the uppermost shoots alone twine. One twines during the middle of the summer but not in autumn. Some grow erect in dry South Africa, their native country; but near Dublin, Ireland, they regularly twine.

Leaf Climbers. — The stems of several species of *Clematis* are twiners like the hop. But in addition to this mode of holding fast, the petioles are sensitive to the touch, slowly bend into the form of hooks, and if successful in catching a stick they clasp it firmly and soon become greatly enlarged and strengthened by an extra growth of woody fibre. If they come in contact with no object they retain this position for a considerable time, and then bending upwards they reassume their original upturned position, which is retained ever afterwards. In *Clematis calycina* the clasped petiole becomes nearly twice as thick as the leaf-stalk which has clasped nothing. The petiole of the unclasped leaf is flexible, and can be easily snapped, whereas the clasped footstalk acquires an extraordinary toughness and rigidity so that considerable force is required to pull it into pieces. The meaning of these changes is plain, namely, that the petioles may firmly and durably support the stem. In some species of *Clematis* furnished with compound leaves the main petiole alone is sensitive, while some have two or three sub-petioles, also sensitive; still others have the entire number, as many as seven, sensitive. Some petioles are extremely sensitive to very light weights, as one-eighth

of a grain. They will clasp thin withered blades of grass, the soft young leaves of a maple, or the lateral flower peduncles of the quaking grass *Briza;* the latter are only about as thick as a hair from a man's beard, but they were completely surrounded and clasped.

The first petiole of *Tropæolum tricolorum* var. *grandiflorum* bear no laminæ or blades, and are very sensitive to touch, sometimes bending into a complete ring in six minutes. The next filaments above have their tips slightly enlarged, and those still farther up the stem still more enlarged; so we find all grades, from tendrils to leaves with large blades. All of these petioles are sensitive; those without blades acting in every way like genuine tendrils; the latter are short lived, however, dropping off as soon as the petioles of the true leaves have clasped the support above. The most remarkable fact, and which I have observed in no other species of the genus, is that the filaments and petioles of the young leaves, if they catch no object, after standing in their original position for some days, spontaneously and slowly move, oscillating a little from side to side towards the stem of the plant. Hence all the petioles and filaments, though arising on different sides of the axis, ultimately bend towards and clasp either their own stem or the supporting stick. The petioles and filaments often become, after a time, in some degree contracted, presenting features much like true tendrils.

Maurandia semperflorens (*Scrophulariaceæ*) has flower peduncles which are sensitive like tendrils, and exhibit revolving powers. These spontaneous movements seem to be of no service to the plant as they lose the power when the flower is old enough to open. The leaf-stalks and internodes of this plant do not twine.

Lophospermum scandens var. *purpureum* when young has sensitive internodes. When a petiole clasps a stick it draws the base of the internode against it; and then the internode itself bends towards the stick, which is thus

caught between the stem and the petiole as by a pair of pincers. The internode straightens itself again, excepting the part in contact with the stick.

With *Solanum jasminoides* (Fig. 88) as in no other leaf-climber examined, a leaf grown to its full size was capable of clasping a stick; but the movement was extremely slow, requiring several weeks. On comparing a thin transverse slice of this petiole with one from the next or older leaf beneath, which had not clasped anything, its diameter was found to be fully doubled, and its structure greatly changed. In the section of the petiole which had during several weeks clasped a stick, the two upper ridges have become much less prominent, and the two groups of woody vessels beneath them much increased in diameter. The semilunar band is converted into a complete ring of very hard, white, woody tissue, with lines radiating from the centre. The three groups of vessels, which, though closely approximate, were before distinct, are now completely blended together. This clasped petiole had actually become thicker than the stem close beneath; due chiefly to the greater thickness of the ring of wood.

Fig. 88.

Solanum jasminoides.

Plants belonging to eight families are known to have clasping petioles, and plants belonging to four families climb by the tips of their leaves. With rare exceptions the petioles are sensitive only whilst young; they are sensitive on all sides, but in different degrees in different plants.

Tendril-bearing Plants. — By tendrils are meant filamentary organs, sensitive to contact and used exclusively

for climbing. They are formed by the modification of leaves with their petioles, of flower-peduncles, perhaps also of branches and stipules. The species of tendril bearers described belong to ten natural families. Species of *Bignonia* and some others taken together, afford connecting links between twiners, leaf-climbers, tendril-bearers, and root climbers. Some little time after the stem of *Bignonia Tweedyana* has twined round an upright stick, and is securely fastened to it by the clasping petioles and tendrils, it emits at the base of its leaves aërial roots which curve partly round and adhere to the stick; so that this one species of *Bignonia* combines four different methods of climbing, generally characteristic of distinct plants, namely, twining, leaf-climbing, tendril-climbing, and root-climbing.

The movements of *Bignonia venusta* are quite complicated. Not only the tendrils but the petioles bearing them revolve; these petioles, however, are not in the least sensitive. Thus the young internodes, the petioles, and the tendrils, all at the same time, go on revolving together, but at different rates. Moreover the movements of the opposite petioles and tendrils are quite independent of each other. One other curious point remains to be mentioned. In a few days after the toes have closely clasped a stick, their blunt extremities become, though not invariably, developed into irregular disk-like balls, which have the singular power of adhering firmly to the wood.

The simple undivided tendril of *Bignonia speciosa* ends in an almost straight, sharp, uncolored point. The whole terminal part exhibits an odd habit, which in an animal would be called an instinct; for it continually searches for any little dark hole into which to insert itself. The tendrils slowly travel over the surface of the wood, and when the apex came to a hole or a fissure it inserted itself, often bending at right angles to the basal part. The same tendril would frequently withdraw from one hole and insert its point into a second one. Mr. Darwin says: "Improbable as this view may be

I am led to suspect that this habit in the tendril of inserting its tip into dark holes and crevices has been inherited by the plant after having lost the power of forming adhesive disks."

A plant of *Bignonia capreolata* was several times shifted in position in a box where one side only was exposed to the light; in two days all six tendrils pointed with unerring truth to the darkest corner of the box, though to do this each had to bend in a different manner. Six tattered flags could not have pointed more truly from the wind than did these branched tendrils from the stream of light which entered the box. When a tendril does not succeed in clasping a support it bends downwards and then towards its own stem, which it seizes, together with the supporting stick, if there be one. If the tendril seizes nothing it does not contract, spirally, but soon withers away and drops off. A bunch of wool was placed in the way of the tendrils; they caught one or two fibres and then the tips began to swell into irregular balls above the one-twentieth of an inch in diameter. The surfaces of these balls secrete some viscid resinous matter, to which the fibres of the wool adhere, so that after a time fifty or sixty fibres are all deeply imbedded in one ball of tendril. These tendrils quite fail to attach themselves to a brick wall. These plants are especially adapted to climb trees clothed with lichens and mosses which abound on the trees in the native country of the *Bignonia*.

Cobœa scandens (*Polemoniaceœ*) is an admirable climber. The terminal portion of the petiole which forms the tendril is sometimes eleven inches long. The tendril performs one revolution against the sun in an hour and a quarter. The base of the petiole and the internodes do not move at all.

A large majority of the tendrils of *Corydalis claviculata* still bear leaflets, though excessively reduced in size. We here behold a plant in an actual state of transition from a leaf-climber to a tendril-bearer. Whilst the plant is young, only the outer leaves, but when full-grown all the leaves, have their extremities more or less perfectly converted into tendrils.

Echinocystis lobata. A thin, smooth, cylindrical, stick was placed so far from a tendril that its extremity could only curl half or three-quarters round the stick. It was always found in the course of a few hours afterwards that the tip had managed to curl twice or even thrice quite round the stick. Measurements showed that this was not due to the growth of the tendril. Whilst the tendril was slowly and quite insensibly crawling onwards it was observed that the whole surface was not in close contact with the stick. The onward movement is supposed to be slightly vermicular, or that the tip alternately straightens itself a little and then again curls inwards, thus dragging itself onwards by an insensibly slow, alternate movement, which may be compared to that of a strong man suspended by the ends of his fingers to a horizontal pole, who works his fingers onwards until he can grasp the pole with the palm of his hand. Experiments upon this interesting plant were made and the results published by Dr. Asa Gray, in 1858. This led Mr. Darwin to more extended observations upon many other climbing plants. He is only one of a large number of persons who are indebted for valuable hints from the sagacious botanist of Cambridge, Mass.

Hanburya Mexicana. In a few days after the tips of the tendrils have grasped an object the inferior surface swells and becomes developed into a cellular layer, which adapts itself closely to the wood, and firmly adheres to it. This is not the extreme tip of the tendril but a trifle back of it. This layer apparently secretes some resinous cement, as it is not loosened by water or alcohol, but is freed by the action of ether and turpentine.

Tendrils of plants belonging to *Vitaceæ*, *Sapindaceæ*, *Passifloraceæ*, and perhaps others, are modified flower peduncles, but their homological nature makes no difference in their action. Figure 89 shows part of the tendril of a grapevine bearing flowers. From this state we can trace every stage till we come to a full-sized common tendril, bearing on

the branch which corresponds with the sub-peduncle one single flower-bud!

Ampelopsis quinquefolia (Fig. 90, tendril, with the young leaf. Fig. 91, tendril, several weeks after its attachment to a wall, with the branches thickened and spirally contracted, and with the extremities developed into disks. The unattached branches have withered and dropped off.) climbs by tendrils like the grape-vine, but in addition has a way of holding fast to plain surfaces by means of little disks or cushions. These disks are apparently never developed without a contact with some object. A tendril which has not become attached to any body does not contract spirally; and in course of a week or two shrinks into the finest thread, withers and drops off. An attached tendril, on the other hand, contracts spirally, and thus becomes highly elastic; so that when the main foot-stalk is pulled, the strain is equally distributed to all the attached disks. During the following winter it ceases to live but remains firmly attached to the stem and to the surface of attachment. The gain in strength and durability in a tendril after its attachment is something wonderful. They adhere still strong after an exposure to the weather for fourteen or fifteen years. One single lateral branchlet of a tendril, estimated to be at least

Fig. 89.

Grape-vine.

ten years old, was still elastic and supported a weight of exactly two pounds. This tendril had five disk-bearing branches of equal thickness and of apparently equal strength, so that this one tendril, after having been exposed during ten years to the weather, would have resisted a strain of ten pounds!

Spiral Contractions.—Tendrils of many kinds of plants if they catch nothing, contract after an interval of several

Fig. 90.

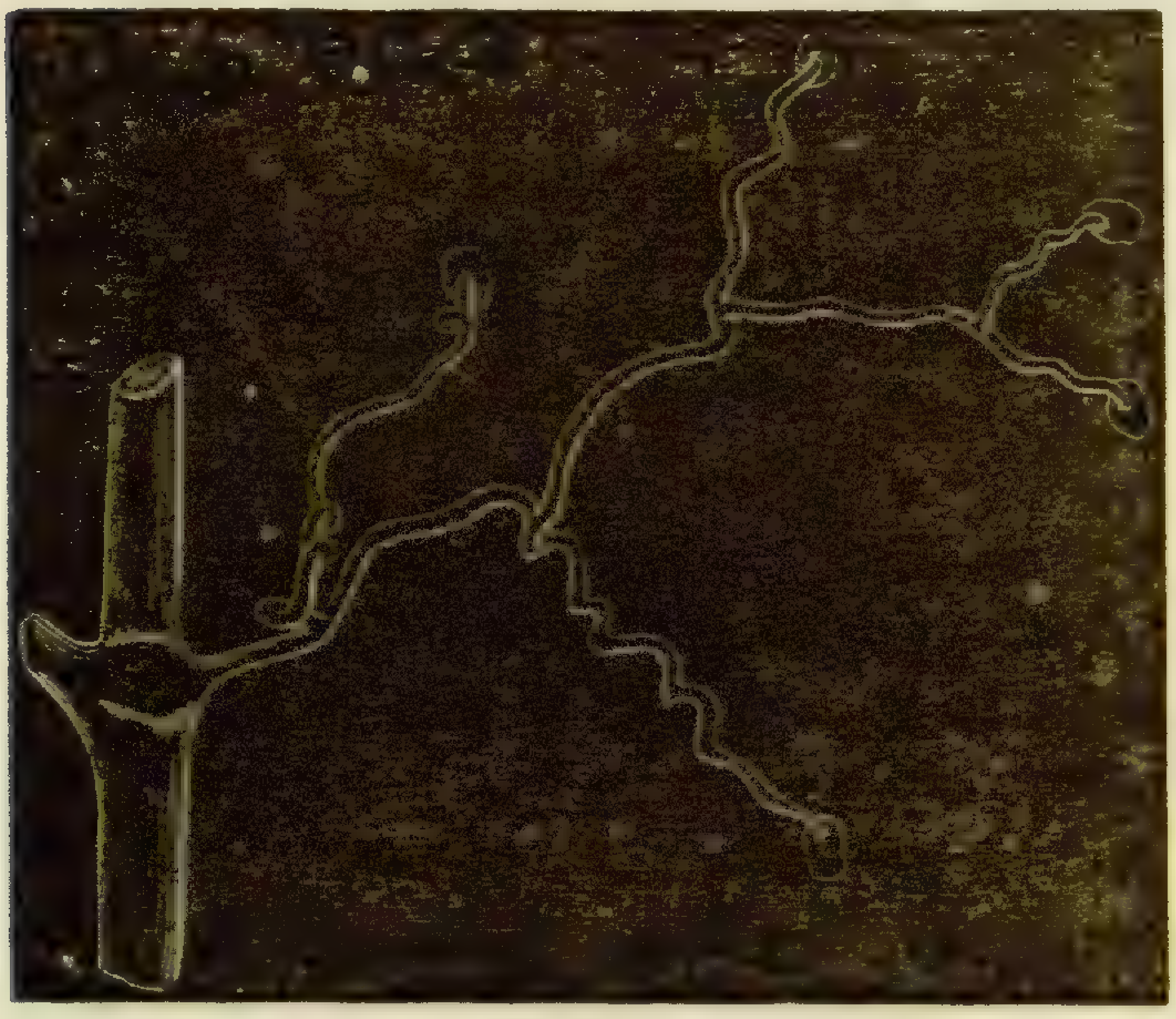
Woodbine.

days or weeks into a close spire. A few contract into a helix.

The spiral contraction which ensues after a tendril has caught a support is of high service to all tendril-bearing plants; hence its almost universal occurrence with plants of widely different orders. When caught the spiral contraction drags up the shoot. Thus there is no waste of growth, and the stretched stem ascends by the shortest course. A far more important service rendered by the spiral contraction is that the tendrils are thus made highly elastic. The strain, as in *Ampelopsis*, is thus equally distributed to the several attached branches of a branched tendril. It is this elasticity which saves both branched and simple tendrils from being torn away during stormy weather. In one case observed

the *Bryony* (Fig. 92) safely rode out the gale, like a ship with two anchors down, and with a long range of cable ahead to serve as a spring as she surges to the storm. When an uncaught tendril contracts spirally the spire always runs in the same direction from tip to base. A tendril, on the other hand, which has caught a support by its extremity, invariably becomes twisted in one part in one direction, and in another part in the opposite direction; the oppositely turned spires being separated by short, straight portions.

Fig. 91.



Woodbine.

Sometimes the spires of a tendril alternately turn as many as five times in opposite directions, with straight portions between them; even seven or eight have been seen by M. Léon. Whether few spires, or many, there are as many in one direction as in the other. To give an illustration; when a haberdasher winds up ribbon for a customer he does not wind it into a single coil; for, if he did, the ribbon would twist itself as many times as there were coils; but he winds it into a figure of eight on his thumb and little finger, so that he alternately takes turns in opposite directions, and thus the ribbon is not twisted. So it is with tendrils, with this sole difference, that they take several consecutive turns in one direction, and then the same number in an opposite direction; but in both cases the self-twisting is equally avoided. *Passiflora gracilis* has the most sensitive tendrils which were seen; a bit of

platina wire, one-fiftieth of a grain in weight, gently placed on the concave point, caused two tendrils to become hooked. After a touch the tendril began to move in twenty-five seconds. Dr. Asa Gray saw tendrils of *Sicyos* move in thirty seconds. Other tendrils move in a few minutes; in the *Dicentra* in half an hour; in the *Smilax* in an hour and a quarter; and in the *Ampelopsis* still more slowly. Tendrils move to the touch of almost any substance, drops of water excepted. Adjoining tendrils rarely catch each other. Some tendrils have their revolving motion accelerated and retarded in moving to and from the light; others are indifferent to its action. America which so abounds with arboreal animals

Fig. 92.

Bryony.

abounds with climbing plants; and, of the tendril-bearing plants examined the most admirably constructed come from this grand continent, namely, the several species of *Bignonia*, *Eccremocarpus*, *Cobœa*, and *Ampelopsis*.

Root Climbers.—*Ficus repens* climbs up walls just like ivy; when the young rootlets were made to press lightly on slips of glass they emitted, after about a week's interval, minute drops of clear fluid, slightly viscid. One small drop the size of half a pin's head, was mixed with grains of sand. The slip of glass was left exposed in a drawer during hot and dry weather. The mass remained fluid during one hundred and twenty-eight days; how much longer was not observed. The rootlets seem to first secrete a slightly viscid

fluid and then absorb the watery plants, and ultimately leave a cement.

Plants become climbers, in order, it may be presumed, to reach the light, and to expose a large surface of leaves to its action and to that of the free air. This is effected by climbers with wonderfully little expenditure of organized matter, in comparison with trees, which have to support a load of heavy branches by a massive trunk. Because these climbing plants graduate into each other they have "become" climbers by gradual changes. This looks too much like the old fanciful theory that has again and again appeared, namely, the giraffe acquired his long neck by a constant desire for high twigs, and an effort to reach them; the elephant his long trunk by a similar desire and effort to reach the grass at his feet. We cannot see how homology indicates descent. We do not believe because the various modes of inflorescence run into each other (*homologous*) that they have all been derived from one common form. Mr. Darwin believes that leaf-climbers were primordially twiners, and tendril-bearers were primordially leaf-climbers; and thinks he understands how the change has been brought about; yet he says "if we inquire how the petiole of a leaf, or the peduncle of a flower, or a branch, first becomes sensitive and acquires the power of bending towards the touched side, we get no certain answer." We are again silenced if we inquire how the stems, petioles, tendrils, and flower peduncles first acquired their power of spontaneously revolving. Below we give a good sample of Darwinism.

"If these views be correct *Lathyrus nissolia* must be descended from a primordial spirally-twining plant; that this became a leaf-climber; that first, part of the leaf, and then the whole leaf became converted into a tendril, with the stipules by compensation greatly increased in size; that this tendril lost its branches and became simple, then lost its revolving-power (in which state it would resemble the tendril of the existing *L. aphaca*), and afterwards losing its pre-

hensile power and becoming foliacious, would no longer be called a tendril. In this last stage (that of the existing *L. nissolia*), the former tendril would reassume its original function of a leaf, and its lately largely developed stipules being no longer wanted would decrease in size." He believes that the capacity of acquiring the revolving power on which most climbers depend is inherent, though undeveloped, in almost every plant in the vegetable kingdom. Notwithstanding his peculiar views, which are so enticing to many, we must acknowledge that he is a shrewd and accurate observer, and that in this paper, as in many others, he has patiently collected a vast amount of valuable information upon a great variety of subjects.

REVIEWS.

NATURAL SELECTION.* — Mr. Wallace has here brought together, in a compact little book, all those essays which have laid the foundation of his great reputation as the author, in common with Mr. Darwin, of the theory of Natural Selection. The modesty of the author, and that admirable judicial coolness of mind which he shares in common with Darwin, is a most persuasive introduction, and produces a favorable disposition in the mind of the reader, which the candid style of treating the different subjects greatly strengthens. In fact we have rarely read a work which has given us so much pleasure and information, and we recommend it to all those who desire to get the principles of Darwinism but have not the patience to spend a longer time over Darwin's work.

The first chapter shows that geological changes determine the variations which take place in the geographical distribution of animals and plants; that closely allied animals are closely associated geographically and geologically, so that "every species has come into existence coincident both in time and space with a preëxisting closely allied species." The author then proceeds to show how variations in animals occur, and incidentally introduces an ingenious and remarkable explanation of the reversions of domesticated types when returned to a feral condition. A domesticated type, when allowed to become wild again, generally speak-

*Contributions to the Theory of Natural Selection. A Series of Essays by Alfred Russell Wallace, McMillan & Co., London and New York, 8vo, p. 384.

ing possesses modifications which are exceedingly disadvantageous; thus they must either regain the original characteristics of their ancestors or become extinct.

In treating of mimicry, or the protective resemblance which many insects have to the bark and leaves of trees, Mr. Wallace is particularly forcible and happy in his illustrations. The *Kallima inachis* and *K. paralexta* are perhaps the most remarkable examples of mimicry. In these two species the wings, when folded, precisely resemble a dead leaf, and since these insects never alight except on withered bushes, they are almost sure to escape detection. "We thus have size, color, form and habits all combining together to produce a disguise which may be said to be absolutely perfect." In the same manner numerous instances are given of similar resemblances occurring between animals in which a harmless species is protected by assuming a resemblance to another species endowed either with stings, disagreeable secretions, or some other peculiarities which render them obnoxious as objects of prey or food to birds. As we have before remarked in dealing with Darwinian theories, we cannot see in all this that natural selection is by any means the primary cause of variation.

Granting that all the variations occur as explained, it seems to become more and more evident that physical changes, or some other unknown causes, give the initiatory impetus to change. According to both Darwin and Wallace a variation must appear, and this variation must in some shape better adapt the animal to its surroundings, its physical wants, before natural selection can act. Thus in the experience of all practical naturalists it acts in such a manner that species have certain local characteristics which they share in common with other species from the same locality. Again, as cited by Wallace, the rise of a mountain system, or other geological revolutions, may produce great changes in the climate and corresponding revolutions in the flora and fauna of a region. We have never been able clearly to see why the plasticity of the organization, and the tendency to vary in any advantageous direction, as seems to be proved by the cases of protective mimicry, might not be acted upon with equal facility by physical causes, natural selection being only the secondary means by which these variations are perpetuated or transferred from individual to individual.

To our minds one of the most remarkable portions of this book is the bold and successful application of the theory to man, and the last chapter which treats of the limitations of natural selection.

It is shown that natural selection would cease to act upon the body after man had once reached a period at which the intellectual faculties began to appear, since then all necessity for farther physical change would be at an end.

"We are now, therefore, enabled to harmonise the conflicting views of anthropologists on this subject. Man may have been, indeed I believe must have been, once a homogeneous race; but it was at a period of which we have as yet discovered no remains, at a period so remote in his

history, that he had not yet acquired that wonderfully developed brain, the organ of the mind, which now, even in his lowest examples, raises him far above the highest brutes; — at a period when he had the form but hardly the nature of man, when he neither possessed human speech, nor those sympathetic and moral feelings which in a greater or less degree everywhere now distinguish the race. Just in proportion as these truly human faculties became developed in him, would his physical features become fixed and permanent, because the latter would be of less importance to his well being; he would be kept in harmony with the slowly changing universe around him, by an advance in mind, rather than by a change in body. If, therefore, we are of opinion that he was not really man till these higher faculties were fully developed, we may fairly assert that there were many originally distinct races of men; while, if we think that a being closely resembling us in form and structure, but with mental faculties scarcely raised above the brute, must still be considered to have been human, we are fully entitled to maintain the common origin of all mankind."

With regard to the limits of the action of this law we quote the following interesting and important argument:

"Mr. Darwin himself has taken care to impress upon us, that "natural selection" has no power to produce absolute perfection but only relative perfection, no power to advance any being much beyond his fellow beings, but only just so much beyond them as to enable it to survive them in the struggle for existence. Still less has it any power to produce modifications which are in any degree injurious to its possessor, and Mr. Darwin frequently uses the strong expression, that a single case of this kind would be fatal to his theory. If, therefore, we find in man any characters, which all the evidence we can obtain goes to show would have been actually injurious to him on their first appearance, they could not possibly have been produced by natural selection. Neither could any specially developed organ have been so produced if it had been merely useless to him, or if its use were not proportionate to its degree of development. Such cases as these would prove, that some other law, or some other power, than "natural selection" had been at work."

The author than proceeds to show that the brain of the savage is uselessly large, being on an average over two and a half times the capacity of that of a Gorilla and nearly seven-eighths of the average Caucasian, or civilized European. This reserve power in the savage, as shown by the size of the unused brain, cannot be accounted for by natural selection, since it is evidently, as shown above, something provided which is not in use and for which a daily necessity does not exist.

The hairless condition of the back in man is also, as pointed out by Mr. Wallace, a characteristic which among naked savages is decidedly a disadvantage and equally unaccountable on the principles of natural selection.

We have already pointed out in previous reviews other cases in which exceptions to the action of the law of natural selection might be found, especially among the fossils. Instead of repeating these remarks we would refer the reader to a series of articles published in the "Scientific Opinion."* These present, by far, the ablest refutation of the universality of application claimed for the great theory of the day. This, together with Professor Dawson's "Modern Ideas of Derivation," reviewed in a previous number of this magazine, and Professor Cope's "Origin of Genera," give fair views of the principal arguments urged against the somewhat unquestioning and hasty acceptation of Darwinism which seems to have become the fashion.

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* The Difficulties of the Theory of Natural Selection. Scientific Opinion, Nov. 10, Dec. 1, 1869. Nos. 54-57, Vol. 2.

And here permit us to repeat, by way of explanation, that Darwinism does not mean the theory of development or derivation, pure and simple, as so many insist, but that explanation of its action by the law of natural selection which is given by Wallace and Darwin. We have no objections to urge against the theory which accounts for the origin of species by descent from some ancient and simpler forms, which might be appropriately called Lamarckianism, but only against the universality of the law of natural selection. This is applied to the solution of the origin of all the various modifications of form and characteristics which have arisen since the first appearance of life upon the globe, whereas it is evidently only a secondary law, active perhaps in all species but subordinated to some other and more comprehensive law still undiscovered.

As regards the origin of man himself our author takes the ground that "some higher intelligence may have directed the process by which the human race was developed by means of more subtle agencies than we are acquainted with.

At the same time I must confess, that this theory has the disadvantage of requiring the intervention of some distinct individual intelligence, to aid in the production of what we can hardly avoid considering as the ultimate aim and outcome of all organized existence — intellectual, ever-advancing, spiritual man. It therefore implies, that the great laws which govern the material universe were insufficient for his production, unless we consider (as we may fairly do) that the controlling action of such higher intelligences is a necessary part of those laws, just as the action of all surrounding organisms is one of the agencies in organic development. But even if my particular view should not be the true one, the difficulties I have put forward remain, and I think prove, that some more general and more fundamental law underlies that of "natural selection." The law of "unconscious intelligence" pervading all organic nature, put forth by Dr. Laycock and adopted by Mr. Murphy, is such a law; but to my mind it has the double disadvantage of being both unintelligible and incapable of any kind of proof. It is more probable, that the true law lies too deep for us to discover it: but there seems to me, to be ample indications that such a law does exist, and is probably connected with the absolute origin of life and organization.

In this connection read the original thoughts in the closing paragraphs on "The Nature of Matter," "Matter is Force," "All Force is probably Will-force," expressed in brief thus: "if, therefore, we have traced one force, however minute, to an origin in our own WILL, while we have no knowledge of any other primary cause of force, it does not seem an improbable conclusion that all force may be will-force; and thus, that the whole universe is, not merely dependent on, but actually *is*, the WILL of higher intelligences or of one Supreme Intelligence."

AMERICAN MICROSCOPES AND THEIR MERITS.* — The first of these papers is an elaborate attempt at an account of American microscopes and their merits; but should have more properly been entitled an attempt to describe the microscopes made by R. B. Tolles, as of the twenty-five pages which it covers, twenty are given to Tolles. The second article

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* On the North American Microscope. By Dr. H. Hagen, Cambridge, Mass. Max Schultz's Archiv für Microscopische Anatomie. Bonn. 2d No. 1870. A communication by Dr H. Hagen on his experience in the use of the microscope. Proceedings of the Boston Society of Natural History, vol. xii, p. 357. March 10th, 1869. A verbal communication on Tolles's and Scheick's microscopes, to the Boston Society of Natural History, November 10th, 1869. Unpublished.

above named, but first in time, is noticed here merely to illustrate some points in the first, and the third, because it was preliminary to the first, which only elaborates more in detail what Dr. Hagen said in his verbal communication, and repeats statements and assertions which at the time they were made, Dr. Hagen was informed, by those as fully competent, to say the least as himself, were erroneous; but in this first named paper Dr. Hagen sees fit to entirely ignore the refutations, and makes the same statements deliberately again, as though there had been no contradiction of them. There is no other course left for those who know him to be wrong or feel aggrieved by his statements, than to examine his qualifications for pronouncing judgment, and to show wherein he is mistaken.

Dr. Hagen being a man of acknowledged scientific acquirements, and holding a reputable position at Cambridge, his opinions, given on a professed detail of facts, and after a *claimed careful study* of two years, published in a journal of high repute in Europe, will command attention and respect there, among those who have no opportunity to see and judge for themselves. If he had stated facts correctly his paper might have been left to itself to refute his "opinions." No one can object to any comparison of American instruments with others; it is only asked that the comparison shall be made fairly, and by a competent expert. The writer proposes to show that Dr. Hagen's investigation has been superficial and inadequate to the task he undertook; and that he has mistaken facts and repeated assertions after he had been informed that they were erroneous.

Dr. Hagen opens his first communication to the Boston Society of Natural History by saying: "Having worked with the microscope more than thirty years for medical and scientific purposes — following the gradual perfecting of the instrument — I was anxious to examine the power [?] of American microscopes." This passage sets forth his claim to be a competent critic.

"During the past ten years there has been great competition among opticians, but in every case their progress has been arrested by one insurmountable obstacle." [What one?] "Since the *recent* improvement in correcting objectives for the thickness of covering glasses, comparatively little has been done." Why he should have restricted the "great competition" to the last ten years, and called the improvements in objectives "recent," when the competition in London has been active for forty years, and the "improvement" was made by Ross nearly or quite thirty years ago, can only be explained by supposing what has been generally believed to be the fact, that the "improvement" and the competion had not reached Germany until the last ten years. So far from little having been done since the "improvement" so much *has been done in England* that the London Microscopical Society, which procured objectives of the "three" leading London artists in about the year 1845, in 1867–8 abandoned the whole of them as behind the times, and obtained new ones of the same makers.

Dr. Hagen then makes some very just observations on "the difference in the aberration of the eyes of the observers. There is no doubt that different observers obtain different results with the same instrument." This is an important fact and an important admission from Dr. Hagen. It is well known to many microscopists, but is generally ignored. It is a pity that it did not occur to Dr. Hagen to remember what he had written in March, when he in October recorded some of his own observations.

The paper in the "Archiv" begins by saying for the past twenty years that the "prominent excellence of American microscopes have been frequently mentioned" and it has been "asserted that their achievements have essentially excelled those of European make." "To my knowledge a direct proof of this has never been exhibited, it has not been shown that anything has been ever better seen than with European instruments." "Thus the American instrument constituted until recently a myth towards which all interested in this branch of science gazed with anxious curiosity, and prompted me during my two years residence in this country, to become *thoroughly acquainted* with it, and I have *spared no pains* to study them carefully." Here we have distinctly the task set forth, and the claim that he spared no pains to accomplish it. Two years of the spare time of a busy man was rather short for the undertaking, especially for one with an imperfect knowledge of the English language. Let us see what were the "pains" taken. "The members of the microscopical section of the Boston Society of Natural History, especially Mr. Bicknell of Salem, Mr. Greenleaf of Boston, Professors Agassiz and Gibbs, Mr. Edwards of New York, and Mr. Tolles himself, have kindly seconded my efforts." Four of these gentlemen certainly were competent to assist. The writer cannot say what Mr. Edwards or Professors Agassiz and Gibbs did for assistance; but he states positively that neither Mr. Greenleaf or Tolles "assisted;" that Mr. Bicknell was the only one of the three who had any intimation whatever of Dr. Hagen's intention of becoming "thoroughly acquainted" with the American microscope, for the purpose of publication; they were never *asked to assist* for any such purpose. Had Dr. Hagen not spared his "pains;" had he enquired for those who could have "assisted" him in his "study" and have given him "positive proofs," he would have been referred to Professor Holmes and Professor Bacon of his own university, and to Professor Smith of Hobart College, New York — *Microscopists* who have made a study of the microscope for twenty years — to Dr. Barnard, Pres. Columbia College, New York; to Professor H. J. Clarke of the Kentucky University; to J. E. Gavit, Esq., of New York; to Dr. F. W. Lewis of Philadelphia; to Professor C. Johnston of Baltimore, to Mr. J. S. C. Greene, jr., of Boston; gentlemen who have made the comparison of European microscopes of the *best makers*, with American instruments almost a specialty; had he done this his study might have produced more correct results; that is if he had given heed to the information he received — for he seems to have disregarded that which he obtained from Messrs. Greenleaf and Bicknell.

Dr. Hagen gives his "general opinion" before giving the details, and says "novelty of any importance is not obtained." Yet before he concludes his paper he enumerates six novelties, all invented or designed by Tolles, namely: his binocular eye-piece; the illuminator of opaque objects with high powers; the low power immersion lens; the solid eye-piece; the mode of effecting adjustment for covering glass, and the amplifier; and overlooks others quite important by Tolles and Zentmeyer.

"Objectives and oculars accomplish with slight variations as much as the best European, never more; on the contrary English and French objectives have accomplished some things which the American have hitherto failed to do." It is not the purpose of this paper to produce evidence outside of Dr. Hagen's own statements, as to what American objectives have done. It is only needful to contrast what he says above with what he says he himself saw. Dr. H. says "that an objective 1-10th inch with ocular C. showed while band 19 [of the Nobert test plate] was in the centre of the field, the 18th, 17th, and half of the 16th bands: the lines in all were *well defined*, but not so that I could have counted them all. I could *count about forty* of the 19th, the rest blurred." "None of Tolles' objectives have well resolved the 16th to 19th bands of Nobert's plates which has been done with the 1-16th of Powell and Lealand." It would seem incredible that the same person could have written the above lines in the same paper; most especially after he had been positively informed by five gentlemen that they had seen the 19th band resolved, and with *several* of Tolles' objectives. But Dr. Hagen takes the ground (though not in this paper, as he should have done) that because *he* did not *count all the lines* at once, that they were not resolved; and it is true that he is not alone in that theory. To show the absurdity of this we will suppose that Nobert had ruled in the 19th band only 28 lines instead of 57, would Dr. Hagen say they were not resolved, when he saw the whole, because there were no more? Or if Nobert had covered a whole inch with the 112,000 and some odd lines, would any one claim that they must all be seen at once? If either of these suggestions are answered in the negative, then Dr. Hagen has himself seen the 19th band resolved with a Tolles' objective. But Dr. Hagen says that American objectives have done "never more than European," and yet what he did with a 1-10th objective, is much "more" than to see all the lines with a 1-16 (really a 1-20). He never saw, read of, or heard of a 1-10 European objective that would do what that one accomplished. This is not all; his sight of the *Surirella gemma* gives the same contradiction to his "opinion." He says "*S. gemma* with the same 1-10 showed only in a few places oblong fields between the cross lines, but not well defined or regular as in Hartnack's drawings." Well, did any one ever see them so? If Dr. Hagen knew as much of diatoms as of insects, he would have been aware of the fact that Hartnack's figure is a theoretical diagram, not a representation of the appearance in the microscope. Probably the only person living who claims to have seen what Hartnack calls the "flat hexagons,"

is Mr. Bicknell, who says he saw them, and only with a Tolles' 1-12. Hartnack does not say distinctly that he has seen them with a 1-16; he attempted to show them to two accomplished microscopists, and both failed to see them. Dr. Eulenstein has also failed with Hartnack's Nos. 10, 11 and 12, Powell and Lealand's 1-50 and Ross' objectives; and Dr. Hagen knew these facts, for the writer told him before his paper was written; comment is unnecessary. Dr. Hagen also says that Hartnack's 1-16 has resolved *S. gemma*, and Tolles' 1-10 has not, ergo Hartnack's has done what Tolles' could not. Dr. Hagen has himself furnished the "direct proof" he wanted of the "unsurpassed excellence" of the American objective.

Now for some of Dr. Hagen's errors and mistakes. He says of Tolles' objectives "the workmanship is superb," "the adjustment only moves the lower lens from the two others." The solid eye-pieces are "really bi-convex Coddington lenses." He gives on the authority of Edwards a formula of Tolles' objectives; all there is to be said, is, that the formula is not Tolles' formula, the eye-pieces are not Coddington lenses, and that Tolles had never made objectives to move the front lens; all of which Dr. Hagen could have easily ascertained.

Dr. Hagen considers that "a most important fault of the instrument consists in the difficulty of its use. In order to adjust them so that they will give their greatest results requires delicate labor and considerable time. In this respect they are excelled by the higher as well as the lower powers of English and German." "The ease of treatment of Hartnack's and Scheick's highest objectives is certainly far less troublesome." If this means anything it must refer to the delicacy of the adjustment for covering glass. Undoubtedly Scheick's are far less troublesome. It is thought to be well known to microscopists that the delicacy of this adjustment — consequently in one sense the difficulty of use — is increased just in proportion to the approach to perfection of the lenses. Certain it is that Hartnack when delivering an objective made for a member of the Boston Society of Natural History two years ago, called the purchaser's attention especially to the fact that when an object was best shown, the movement of the adjusting ring one hundredth of an inch either way destroyed the effect, as an evidence of the perfection of his work. As to English objectives. Dr. Piggott in a recently published article on high power objectives, speaks of a certain effect being entirely destroyed by a change of this adjustment which moved the lens only 1-14.000 of an inch. So much for English lens and Hartnack's. Microscopists know that Dr. Hagen is in an error as to good objectives, but correct if his remarks are applied to poor ones; and it is not surprising that he was "*utterly astonished* to see how much more the hand of the artist himself will develop with the instrument."

The majority of the microscopists here are "dilletanti or workers on diatoms;" this must be news to Professors Holmes, Bacon, Ellis and Gray, and to their hundreds of past and present students; the "truth will be

respecced" if it is said that there are hardly enough diatomists in the whole country to encourage each other.

Dr. Hagen thinks that his attempt at "even pronouncing a judgment on the local instruments, caused a storm of indignation against me by the resident microscopists," and accounts for it by the assertion that "*we know* that most of them are members of the Boston Optical Association." Dr. Hagen here refers to the reception of his verbal communication to the Boston Society of Natural History in November last. Of all the persons then present but two were members of that association, and whatever indignation was manifested was at his preposterous comparisons of cost. Dr. Hagen then asserted that the American instruments cost 600 per cent. more than German of equal merit, and that "English objectives of the most celebrated makers could be imported to advantage." In his paper in the "Archiv" Dr. Hagen reduces the comparative cost of German and French objectives to "one-third or one-fourth as much," but repeats his comparison as to the English "according to Frey's statement." Now before this paper was written the cost of importing English objectives was read in detail to Dr. Hagen, and it was shown from the makers' price lists that the cost was much higher than Tolles' prices for similar objectives, and yet Dr. Hagen elects to repeat his erroneous statement. He said then that he "spoke for the interest of science." Can the interest of science be promoted by such misstatements? It was not the intention of the writer to have said anything more on the matter of cost, but while writing this paper a letter was received, an extract from which is a good comment on all that Dr. Hagen has said as to cost and workmanship. It is not known that the writer of the letter ever heard of Dr. Hagen or his comparisons. The letter was written by Colonel J. G. F. Holston, M.D., Washington, D.C., June, 1870. "I was never dissatisfied either with Tolles' prices or his workmanship, for although apparently dearer than some other makers, the superior excellency more than balances it. I can do with my 1-12th by Tolles (cost $100), all that Powell and Lealand's 1-50th will do well that cost the United States $350. I compared them myself at the museum." Dr. Barnard, President of Columbia College, New York, writes, "Dr. Hagen is absurdly wrong in his comparison of the performance of the American and foreign objectives of the same price." "It is nonsense to make such comparisons as these price for price."

No less unfortunate is Dr. Hagen in his description of Tolles' first class instruments; he partially describes the plan and construction of some instruments which he had seen — omitting, however, some of the most peculiar details — and mixing with that some of the peculiarities of an unique instrument, the only one of the kind ever made, and which he has never seen, the particulars of which he could have got from Dr. Barnard's report of the Paris Exposition of 1867 — constructing in this way an instrument which has no existence. He claims to have "seen and tested nine of Tolles' instruments of the largest class." The writer will

not say that is impossible, but he can say that there are no nine instruments of the "largest class" known to Mr. Tolles that Dr. Hagen could possibly have seen and tested. His classification must be treated as an error until he furnishes a list of the nine. The self-sufficiency with which he charges the reverend President of Columbia College with making, in his official report of the Paris Exposition, a claim that is "hardly tenable" is, to use his own expression, "quite comical." Dr. Barnard had reported that "it was to be regretted that the American makers did not send" stands to the exhibition; for the want of them the objectives were not properly examined. Dr. Hagen twists this round in this way. "The same objectives are frequently used here with English stands and occulars, plenty of which were to be had in Paris. If, then, they did not prove themselves successful the *reason must be* that they did not attain as much as others. The circumstances of the difficulty of their adjustment is not to be allowed in this case as the reporter (Barnard) himself is an adept in their use," all of which is entirely imaginary with Dr. Hagen. A recent letter from Dr. Barnard recites the whole story. He says: "In regard to what Dr. Hagen says of my report, he so singularly misunderstands me, or so wilfully misrepresents that it seems hardly necessary to reply to him. I never said or intimated that a Tolles' stand was necessary to develop a Tolles' objective, but only that a stand of some kind was necessary, a proposition which I think stands to reason. The disadvantage could not appear until the jury, instead of examining the glasses, country by country, as I supposed they would, using certain uniform tests, ordered at once all the exhibitors of microscope objectives to present their glasses simultaneously in one place (and that, by the way, as bad a place as could be selected, a small room with one window, a moderately sized table, and no chairs). Had the first plan been pursued there would have been no trouble about stands, for Mr. Beck of London was close by the American section with a case full of apparatus, including stands of all forms, one of which he subsequently placed at my disposal for some length of time. But when the crowd came together at the place appointed, the American glasses were present without any stands, and though both Mr. Ross and Mr. Beck, *after their own glasses had been examined*, permitted me to make use of their stands, the weariness of the protracted examination, with the extreme heat of the crowded room, made the jury impatient, and notwithstanding the compliment Dr. Hagen pays me as an "adept," I was not smart enough to secure, on that occasion, what I thought a fair trial of the glasses — by which expression I mean *not* a fair development of their powers, but a fair *attention* to their development. *I never got the whole jury to examine the glasses thoroughly.* After I had obtained from Mr. Beck a stand, Dr. Brooke of London, made the fullest trial with them which I could secure from any member, and he expressed himself favorably, though he has the natural national leaning of an Englishman. It would have been ridiculous for me to narrate all this in my report, but it is absurd for any one to interpret what I do say

as Dr. Hagen does." That effectually disposes of Dr. Hagen's inferences, that the American objectives "did not attain so much as others."

Dr. Hagen attempts to controvert the opinion now unanimously received in England and America, that the microscope should be so constructed as to receive an inclination. He says, "the statement made by people here that the working with high stand instruments (they being turned back) is much more convenient, as keeping the neck straight prevents the rush of blood to the head, makes rather a comical impression. I say comical, when we consider that for tens of years back several thousand low stand instruments have been in daily use in Europe without detrimental results." [?] Possibly no one but Dr. Hagen has ever heard that the use of vertical instruments caused a rush of blood to the head; but the experience of all microscopists here (Dr. Hagen excepted), is against the use of the low stand vertical instruments, and that evils and imperfect work do result from the use of such. To show that the "comicality" of the objection is not original with American microscopists, the following is extracted from Dr. Wm. B. Carpenter's work on the microscope, — an author whose opinion is certainly equal to Dr. Hagen's thirty years experience — written fifteen years ago. "Scarcely less important * * * is the capability of being placed in either a vertical or a horizontal position, or at any angle with the horizon, without deranging the adjustments of its parts to each other," * * * * "It is certainly a matter of surprise that opticians, *especially on the continent*, should have so long neglected the very simple means which are at present commonly employed in this country of giving an inclined position to microscopes, since it is now universally acknowledged that the vertical position is, of all that can be adopted, *the very worst*." Perhaps if Carpenter's work had been translated into German fifteen years ago it might not have been needful to write this paper.

Dr. Hagen has so little to say of American microscope makers, other than Tolles, that he found it impracticable to make so many mistakes in regard to them. If he had taken more "pains" he could have added materially to the number.

Of Spencer he says: "A few years ago, however, he retired from the business." This is a mistake, for which probably Dr. Hagen is not responsible. "I have not in fact had an opportunity to compare Spencer's objectives and oculars." "In Boston, Salem, and Massachusetts generally, there are none of Spencer's instruments to be found;" that is because he "spared the pains" to find them. The writer had them, and would have guided the enquirer to others.

Of Zentmeyer he remarks: "As near as I can find out he makes no glasses. Each of his stands that I saw had objectives and oculars of Tolles or Wales." Another example of the superficial knowledge obtained by Dr. Hagen; a portion of the very oculars which he saw on Mr. Bicknell's instrument, and which he gives the power of as Tolles, were made by Zentmeyer! Had he not "spared pains" to inquire, he could

have learned that Zentmeyer does make glasses, and that one of the Tolles' stands which he had seen was furnished with an excellent objective by Zentmeyer. In the notice of Zentmeyer's stand the most important and characteristic features are entirely unnoticed!

In his notice of Grunow's instruments he particularizes an inverted microscope, the peculiarity of which was a movement by friction rollers, an invention of Tolles, and which he (Hagen) had seen various modifications of on several of Tolles' instruments, in particular the first one in which it was ever introduced; yet he failed to notice it there.

It may, perhaps, be urged for Dr. Hagen that these things are trivial, and to some they may look so; but they constitute Dr. Hagen's paper; the aggregate of the trivialities makes about the whole. Dr. Hagen fails throughout all his papers to appreciate the difference between magnifying power and quality.

With a patronizing air that is "nearly comical," after reading the paper, he compliments the artists in these words: "Messrs. Tolles and Wales are no doubt artists of the first water, constantly endeavoring to advance and enlarge their science."

Dr. Hagen admits that he has not exhausted his subject, and promises to renew it; it is to be hoped that he will, and that when he does he will spare no pains to make himself thoroughly acquainted with it; if he endeavors to do that, all our microscopists will cheerfully assist him. — C. S.

Alaska and its Resources.* It is not often that an exploration is able to show such results as Mr. Dall places before the public in this volume, even when assisted by public means. We cannot, therefore, praise too highly the modest manner in which the author tells us that he was unwilling to have the plans of the former director, Major Kennicott abandoned, and therefore, undertook to carry out the remainder of the explorations which were only half completed when the telegraph company abandoned the enterprise. The author was thus left alone for one year and succeeded in completing the survey of the Yukon Valley, unassisted except by the natives. As a thorough and reliable account of Alaska, with its pictures of subarctic nature, the substantial volume before us, with its beautiful illustrations, typography, paper and binding, will claim the highest rank and retain it for years to come. We feel proud of this elegant book, and that it is the fruits of American pluck, enthusiasm, and scientific zeal.

Many of the scientific results obtained by Mr. Dall have been already published in the Naturalist, and the great value of his discoveries in a single department of zoology, *i.e.* that of ornithology, were passed in review in the last number by an able naturalist. In reading over the plain, unvarnished, modest narrative of personal adventure and explorations in Alaska, we are struck by the earnest endeavor of the author to

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* By William H. Dall. Lee and Shepard, Boston, 1870. 8vo, pp. 627. With a map and numerous illustrations. $7.50.

make his statements thoroughly reliable. Alaska is in most respects a new country,—the hand of civilized man has scarcely made its mark on the face of nature, the Indians and Innuits will soon disappear, domesticated and introduced species of animals and plants have scarcely taken up their abode and begun to wage war against the native species, and just at this juncture the record of a naturalist who has watched the changes of each season for two years in succession is a contribution of the first importance to science.

The first half (Part I) of the book is a personal narrative of travels on the Yukon River and in the Yukon territory, the first year as Director of the Scientific Corps of the Western Union Telegraphic Expedition; the second year he remained after the expedition returned, and prosecuted his explorations alone and at his own expense. The second part treats of the geography, history, inhabitants, and resources of Alaska.

In reading the narrative we occasionally meet with a paragraph of general interest to our readers. Let the author give us his first impressions of the Yukon:

"Passed over (p. 41) the flanks of some high hills, from one of which I caught my first glimpse of the great river Yukon, broad, smooth, and ice-bound. A natural impatience urged me forward, and after a smart tramp of several miles we arrived at the steep bank of the river. It was with a feeling akin to that which urged Balboa forward into the very waves of a newly discovered ocean, that I rushed by the dogs and down the steep declivity, forgetting everything else in the desire to be first on the ice, and to enjoy the magnificent prospect before me.

There lay a stretch of forty miles of this great, broad, snow-covered river, with broken fragments of ice-cakes glowing in the ruddy light of the setting sun; the low opposite shore, three miles away, seemed a mere black streak on the horizon. A few islands covered with dark evergreens were in sight above. Below, a faint purple tinged the snowy crests of far-off mountains, whose height, though not extreme, seemed greater from the low banks near me and the clear sky beyond. This was the river I had read and dreamed of, which had seemed as if shrouded in mystery, in spite of the tales of those who had seen it. On its banks live thousands who know neither its outlet nor its source, who look to it for food and even for clothing, and, recognizing its magnificence, call themselves proudly *men of the Yukon.*

Stolid indeed must he be, who surveys the broad expanse of the Missouri of the North for the first time without emotion. A little Innuit lad, who ran before the dogs and saw it for the first time, shouted at the sight, saying, amidst his expressions of astonishment, 'It is not a river, it is a sea!' and even the Indians had no word of ridicule for him, often as they had seen it."

The anthropologist will glean much valuable information from the narrative, while the second part on the manners and customs of the natives, is an important contribution to American anthropology. On page 127, in describing the Innuit casine, or town hall, it is stated that

"There is not a nail or a pin in the whole structure, which is of the most solid description. Some of the logs are two feet in diameter, and the broad seats on both sides, previously referred to, are each composed of a single plank forty-four inches wide, thirty feet long, and four inches thick. These enormous planks are from drift logs, and were hewn with the stone axes of the natives."

Of the bears, the number of North American species of which is now in dispute:

"There are three species: the large brown bear of the mountains, known as the 'grizzly" among the Hudson Bay voyagers; the barren-ground bear (*Ursus Richardsonii* of Mayne Reid), which is confined in Russian America to the extreme north-east; and the black bear,

which frequents the vicinity of the Yukon, in the woody district only. The polar or white bear is found only in the vicinity of Behring Strait, on the shores of the Arctic Ocean, and on St. Matthew's Island in Behring Sea. It has probably reached the latter locality on floating ice; we only know of its existence there from whalers, who apply the name of Bear Island to the locality, from the abundance of these animals. We know that it is not found on the mainland south of latitude sixty-five degrees. The cubs of the black bear are of the same color as the parent, and the adult is very much smaller than its brown cousin, which sometimes reaches a length of nine feet, with a girth nearly as great. The brown bear, or grizzly, is the only one which manifests any ferocity, and it always avoids any contest unless brought to bay."

Regarding the remains of the extinct elephant (*Elephas primigenius*), which are not uncommonly found on the surface, the author says:

"I picked up near the village a large portion of the skull of the extinct elephant (*Elephas primigenius*). These bones are not so common as the teeth and tusk, being found on the surface only, and usually much decayed: while the bones of the musk-ox and fossil buffalo found in the same situations are much better preserved, and sometimes retain some of the animal matter in the bone. The natives have no tradition of any other large animal than the reindeer and moose, and regard the elephant and musk-ox bones as the remains of dead 'devils.' The tusks are not so well preserved as those found in Siberia, which are usually buried in the earth. The former are blackened, split and weathered, and contain little ivory in a state fit for use, though the Innuit of the Arctic coast occasionally find them in such preservation that they make kantags or dishes of the ivory, according to Simpson."

The chapter on the geography of Alaska gives a full acount of the general topographical features of the territory, and many useful details with regard to the navigation of the shores and adjacent islands. This is a very perfect summary of all that is known of the physical history of this portion of the North Pacific, and it shows us, also, perhaps the most important result of the expedition. This was the demonstration of the cessation of the Rocky Mountains, at a point about one hundred and fifty miles south-east of Fort Yukon.

"The Rocky Mountain chain extends east of the basin of the Yukon, between it and the Mackenzie, as far north as latitude 64°. Here it bends westward, and, becoming broken, passes to the west and south, combining with the coast ranges to form the Alaskan range." This last follows the shore line to the westward, and thus the only considerable exception to the orographic law that mountain chains trend in the same direction with the coast seems to be explained, and geographers can no longer lay down the northern extension of the Rocky Mountain as reaching to the shores of the Arctic Sea. The fauna of the Yukon is almost wholly Eastern Canadian, showing that the mountains had interposed no insurpassable barrier to the north as they had to the south of the Alaskan and west of the Rocky Mountains proper.

The soil of the Yukon Valley is always frozen at the depth of three or four feet, and in some cold situations remains icy near the surface. "This layer of frozen soil is six or eight feet thick." "This phenomenon appears to be directly traceable to the want of drainage, combined with the non-conductive covering of moss," which prevents thawing in the summer heats. Nevertheless this frozen soil has "a healthy and luxuriant vegetation, bearing its blossoms and maturing its seeds as readily as in situations apparently much more favored."

But next in value to the geographical details are the many authentic

facts regarding the natives now so rapidly disappearing. By learning to speak their language, and living among them, his testimony is of special value, and he says that he was enabled to correct many erroneous impressions formed early in his visit to the country, by more careful and repeated observations and knowledge of their language. Of the Esquimo he made a special study, and cautiously remarks (on p. 154) that "it is impossible to doubt that among all American aborigines, much in their mode of life, customs, and ceremonials is of a local nature, and due to extraneous circumstances. Much is also due, unquestionably, to the similarity of thought and habit which must obtain among human beings of a low type, and who gain their living by similar means. Hence, a general similarity of many customs may naturally be expected between both Innuit and Indians, as well as for distant aborigines of different parts of the world, and this similarity can afford no basis for generalizations in regard to their origin."

As regards their affinities, he writes: "It should be thoroughly and definitely understood, in the first place, that they are not Indians; nor have they any known relation, physically, physiologically, or otherwise, to the Indian tribes of North America. Their grammar, appearance, habits, and even their anatomy, especially in the form of the skull, separate them widely from the Indian race. On the other hand, it is almost equally questionable whether they are even distinctly related to the Chukchees and other probable Mongolian races of the eastern part of Siberia" (p. 137). As to the origin of the word Eskimo we are told that "the Indians call the Innuit and Eskimo *Uskeémi*, or sorcerers. *Kagus-keémi* is the Innuit name for the Casines, in which their Shamáns perform their superstitious rites. From this root comes the word Eskimo."

In the chapter on the aboriginal inhabitants of Alaska, he begins by dividing the inhabitants into Indians and *Orarians*, the latter embracing the tribes of Innuit, Aleutians and Asiatic Eskimo. The author is inclined to reject the theory most in vogue that America has been peopled from Asia or Polynesia, and "proposes to attempt to show that some of the facts which have been used in support of this hypothesis are susceptible of quite another interpretation. I refer to the existence of tribes of Orarian stock on the coast of the Chukchee Peninsula," which were originally derived from America, their emigration having taken place within three hundred years. He adds beyond that "there is no doubt but that the Aleutians originally emigrated to the islands from the American continent, driven by hostile tribes. The Innuit formerly extended farther south than they do now, and in this connection we find the suggestive remark that "Dr. Otis, of the United States Army Medical Museum at Washington, who has handled as many aboriginal American crania as any northern ethnologist, says that the skulls found in the northern mounds have the same peculiarities which distinguish all Orarian crania, and that both are instantly distinguishable from any Indian skulls."

The chapters on the climate and agricultural capabilities and geology,

and the whole tenor of the remarks on this subject leads the reader to the belief that the purchase of Alaska was wisely made by our government.

TROUT CULTURE.* — This is just the book that has been wanted by every one interested in the raising of fish by artificial propagation. It contains a statement of the experience of the most successful fish breeder in the country, presented in concise and forcible language; every word fully convincing the reader that the author is simply giving the results of his experience, with the earnest desire of furnishing others with all the information necessary for them to become as successful breeders of trout as himself. With this book in hand, and a proper location and supply of water, there is no reason why trout raising should not succeed in the hands of any careful and energetic person. In fact nothing but pure carelessness could make it fail, though, like all other stock raising operations there are many things that should be looked after before the eggs are placed in the hatching house; and as no sheep raiser would purchase five hundred sheep for his farm unless he had what he knew to be sufficient pasturage for so large a number, so no trout raiser should purchase his five hundred or more trout eggs unless he has plenty of good water. We have not space for the extended review of this little work which our interest in the subject would otherwise lead us to make, and can only say that every point is fairly and plainly presented, from the location of the pond, its best depth and shape, its bottom, its screens and water supply; to the transportation of eggs and live fish; and all the intermediate operations of procuring the eggs in different ways, the construction of the hatching house, handling the eggs and young fish; with observations on their diseases and enemies; careful statements regarding the amount of water required for each fish of different ages, etc., etc. In fact every information that long continued and successful operations enables the author to feel confident is just what beginners want, is here given. An improved spawning screen, invented by Mr. Collins (Mr. Green's partner), is described and figured. This screen or box is so designed as to secure the eggs of trout and other fishes that have been spawned in a natural way, and is a most convenient and labor saving contrivance for the trout breeder. We hope to give a communication on this subject in a future number.

There are several facts very interesting to the naturalist alluded to by Mr. Green. The average age of a trout he thinks to be about twelve or fourteen years, and that trout are in their prime during the age of from three to ten years. Mr. Green also states that trout will *not* live in water the temperature of which is above 68°, and do best at a temperature of 48°.

On the last page of the book Mr. Green calls attention to a "worm"

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* *Trout Culture.* By Seth Green. 12mo pamph., pp. 92. Green and Collins, Caledonia, New York. [For sale at the Naturalists' Agency, Salem. Price $1.00.]

which is very destructive to young trout and other fish, by catching them in webs which are spun under water.

"The web is as perfect as that of the spider, and as much mechanical ingenuity is displayed in its construction. It is made as quickly and in the same way as a spider's, by fastening the threads at different points and going back and forth until the web is finished. The threads are not strong enough to hold the young trout after the umbilical sac is absorbed, but the web will stick to the fins and get wound around the head and gills and soon kills the fish."

This "worm" is, according to an article in the June number of the "American Entomologist and Botanist," the larva of the notorious Black-fly, or at least of a species of the same genus, *Simulium*, and is figured in the "Entomologist," where also there is an important article on the transformations of this pest to fishermen, and as it now turns out to fishes also.

Messrs. Green and Collins are ready to supply persons with trout eggs at $10 for a single thousand, or young trout at $30 a thousand, to any extent required, from their farm at Caledonia, and as both eggs and young can be, and have been, sent in perfect safety to various parts of the country, and even to France and England, there is now no reason why every northern stream should not have its supply of "spotted beauties."

Record of American Entomology for 1869.* — After a greater delay than was anticipated this "Record" has at length appeared. The editor states in the introductory that "the number of American entomologists whose articles or notes are referred to in the "Record" is fifty-two; while three hundred and thirty-five new species of North and Central American insects have been described in American journals during the year 1869." We are glad to notice that our American entomological literature has assumed a highly practical character, and comprises much regarding the habits of insects, a never failing source of interest. The remarks by Baron Osten Sacken should be carefully read by every entomologist, especially the beginner, and are well worth the price of the whole pamphlet.

Brazilian Crustacea.† — In this carefully prepared essay Mr. Smith remarks that "the collection, although quite small in number of specimens and representing only the higher groups of the class, is interesting from the large proportion which it contains of species heretofore known only from the West Indies or Florida. This is, perhaps, due chiefly to the fact that most of the collections brought from Brazil have been made at Rio Janeiro, where there are no coral reefs, while Professor Hartt's collection was made principally on the rocky and reef-bearing parts of the coast." Five new species are described, and a new genus, *Xiphopeneus* (*X. Hartii*). The plate is lithographed from photographs and is of unusual excellence.

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* For sale by the Naturalist's Book Agency, Salem. July, 1870. 8vo. pp. 62. Price $1.00.

† Notice of the Crustacea collected by Professor C. F. Hartt on the coast of Brazil in 1867, together with a List of the described species of Brazilian Podophthalmia. By Sidney I. Smith. (From the Transactions of the Connecticut Academy of Arts and Sciences. Vol. 2, 1870. 8vo, pp. 41.)

THE POPULATION OF AN OLD PEAR TREE.*—The author in these charming stories of insect life relates his experience with various forms of insects which visited an old pear tree in his garden, weaving in many satires on human life, and an occasional sly thrust at professional entomologists who look on bugs simply as bugs and not as part and parcel of nature. It is an admirable book to place in the hands of boys and girls. The illustrations are capital, reminding us of the grotesqueness and strong effects seen in Doré's drawings on wood, and form a marked feature and attraction of the book.

THE AMERICAN MUSEUM OF NATURAL HISTORY.† — Under this title there has been established in the city of New York a museum in whose list of trustees we recognize many names well known to the citizens of the metropolis. While we honor these gentlemen for their public spirit we do not see even from their report how it was that they thus suddenly became possessed of such a determined desire to found a museum.

We believe that New York will eventually possess the finest and largest museum in the country, just as they now have the most beautiful park. There is, however, one mistake which we might notice, the futility of amassing fragile collections, building cases, having zoological gardens, etc., without at the same time appointing men who are competent to use them for the benefit of the public. From what we have seen of the efforts of the directors, or whoever has in charge the large collections in the third story of the arsenal building, we should say that they do not seem to possess even that slight knowledge which five minutes criticism from any competent scientific man would have given them. We have never in our experience of the unscientific attempts to build museums seen anything so entirely unfit for its purpose as the large two-storied case which occupies the centre of the arsenal hall. No one but a physician, or a committee of such, well acquainted with hospital practice and hygiene, would presume to attempt the erection of a hospital. Engineers are generally called upon to build railroads and steam engines, but in natural history all this is reversed, and we do not seem to have yet learned that it requires a naturalist to plan a natural history building. We understand, however, that efforts are being made to place some well qualified naturalists in charge of the executive department, and we hope to see a change in this respect before the next report is published.‡

The menagarie will afford materials for the formation of a collection of comparative anatomy which would be both amusing and instructive to visitors, but this does not seem to have been thought of. The board of management, also, appear to be drifting to stuffed skins of birds and

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* The Population of an old Pear Tree: or Stories of Insect Life. From the French of E. van Bruyssel. Edited by the author of the "Heir of Redclyffe." With numerous illustrations by Becker. 12mo, pp. 221. New York. Macmillan & Co. 1870.

† First Report of the Trustees.

‡ Since the above was written, we have become aware, also, that the Commissioners have taken professional advice as regards the construction of their cases.

mammals. The accumulation of the latter would most certainly be of great benefit, but a large collection of the former would simply duplicate the museums of Philadelphia and Boston.

Our strictures are wholly due to a desire to awaken the directors of this museum to the importance of avoiding the errors of their predecessors. There is no reasonable excuse for a board of management which, at the present day, repeats the mistakes which have characterized the past history of all the museums with which we are acquainted, either in this country or Europe. We recommend especially to their perusal a short article upon the "Scientific Institutions of North America," by George Bentham in his Annual Address to the Linnæan Society, for 1867, and the various articles frequently published upon the proper management of museums and kindred topics in "Scientific Opinion" and "Nature."

Efforts are, however, being made to change this state of affairs, and we hope to report in our next notice that the American Museum is, in all respects, worthy of the name that it has taken, and of the city that should have a museum unequalled by any in the country.

NATURAL HISTORY MISCELLANY.

BOTANY.

FRAGARIA GILLMANI. — In a note on this plant by Mr. Gillman, page 312, it is stated that Dr. Asa Gray considers that the "well developed leaf on the scape, proves to be the distinguishing character of the species." It is not clear whether this refers to *F.* "*Mexicana*," or *F.* "*Gillmani*;" but to show that neither can lay claim to this character exclusively I enclose a leaf of *F. vesca*, in which are not only well developed leaves on the scape, but better developed leaves than I have yet seen on *F.* "*Gillmani.*"

In my note on *F.* "*Gillmani*" last year I stated that leaves on the scape, or flowers on the runners were poor characters to found species on, because a flower scape is nothing but an erect runner, and a runner but a viviparous scape. In this specimen, now sent, you will see this illustrated by the *rudiments of roots*, as well as leaves on the scape. — THOMAS MEEHAN.

[We understand Dr. Gray to have remarked that all the specimens he has seen of Schlechtendal's *F. Mexicana* have leaf-bearing scapes, and that *F. Gillmani* is the same thing; and that he has no decided conviction as to whether it be the European *F. vesca* which has assumed this condition and habit in Mexico, or an aboriginal form, — which in either case is curious. — EDS.]

New Plants. — In my botanical rambles this last May two new plants came under my own observation. One of them which we have made known as *Viola erecta*, was found near Williamstown, Mass., and is a variety of *V. Selkirkii*, differing from that species in its larger size and in its leaves being strictly erect and not lying flat upon the ground. The other which was discovered at Binghamton, N. Y., and called by us *Geranium album*, has a white flower with yellow anthers and leaves, but little hirsute characteristics which mark it as a distinct variety of *G. maculatum*. — H. M. Myers, *Williamstown, Mass.*

Palms of the Sandwich Islands. — In the interesting popular account of palms, contributed by Dr. Seemann to the "Gardener's Chronicle," it is mentioned that three species of *Pritchardia* are known from these islands, namely, *P. Martii* and *P. Gaudichaudii* (briefly noticed by Martius under the name of *Livistonia*, from very imperfect materials furnished by Gaudichaud), "and an undescribed species enumerated by Horace Mann." It is farther noted that none of these species are yet introduced into cultivation. There is, however, no evidence to show that the palm noticed by the late Mr. Mann is different from one or the other, not to say both, of Gaudichaud's; and it is here well known that Mr. Mann brought a stock of seed of his palm, from which numerous young plants were raised both in this country and at Kew. Of these the best developed specimen known belongs to the collection of H. H. Hunnewell, of Wellesley, Mass.

The Irritability of the Stamens in the Barberry, according to Jourdain ("Comptes Rendus" April 25th), is suspended by chloroform. A bit of cotton sprinkled with chloroform, and introduced into the *glass* bell-glass which covered the plant operated on, produced tetanic rigidity of the filaments in one minute; but exposure to the air soon restored the irritability, unless the action of the chloroform had been continued ten or twelve minutes, in which case the vitality of the flowers was greatly impaired or destroyed. — *Academy.*

ZOOLOGY.

The Future of Natural Science. — We had heard it stated that henceforth physical discovery would be made solely by the aid of mathematics; that we had our data, and need only to work deductively. Statements of a similar character crop out from time to time in our day. They arise from an imperfect acquaintance with the nature, present condition, and prospective vastness of the field of physical inquiry. The upshot of natural science will doubtless be to bring all physical phenomena under the dominion of mechanical laws; to give them, in other words, mathematical expression. But our approach to this result is asymtotic; and for ages to come — possibly for all the ages of the human race — nature will find room for both the philosophical experimenter and the mathematician. — *Tyndall's notice of the "Life and Letters of Faraday" in the Academy.*

THE PIGEON HAWK. — Mr. Samuels, in his work on the "Ornithology and Oology of New England," says that he never saw a nest of this bird, and never heard of but one instance of its being found in New England, but he adds that it doubtless breeds here. This may be true, but it seems to me almost as though he really could not have inquired into the matter, for in this very town (Amherst, Mass.), I know of three positive instances of the nest being found; they all were in holes of trees; in two there were four eggs, and in the other five; the last mentioned one was discovered this year; there can be no doubt as to the identity of the eggs, so I do not hesitate to show this fact. The bird seems to be comparatively common here. It seems to me as if this bird is so often here, and found to breed here, it must be that some other town or state in New England receives its due share of attention.—WINFRID STEARNS, *Amherst, Mass.*

THE FLIGHT OF BIRDS AND INSECTS. — M. Marey has recently shown that birds and insects fly in a totally different manner. In birds the extremity of the wing describes a simple helix, while in insects it passes through a series of lemnises (lemniscates, or figures of eight). The author has studied this intricate subject by means of two very ingenious machines, one of which, by a very simple arrangement, indicates very precisely the flight of an insect; while the other made to be placed on the back of a bird, transmits all the movements of the wing to a receiver which faithfully records them. — *Cosmos.*

PÆDOGENESIS IN THE STYLOPIDÆ. — Professor von Siebold has discovered that the so-called female of Xenos is in reality a larva, and that it produces its young by germ balls like those of the larva of Cecidomyia (Miastor) which produces larvæ like itself during the winter months, but in summer undergoes the usual transformations of these gall flies. This child-reproduction, in individuals without true ovaries, was aptly termed by Von Baer "Pædogenesis."—*Siebold and Kölliker's Journal of Scientific Zoology.*

CURIOUS CONDUCT OF A SHARP-SHINNED HAWK. — On the 6th of April, while wandering along the Shabbaconk Creek, near Trenton, N. J., I sat down on a convenient mat of dead grass to observe the movements of the "red-fins" (*Hypsilepis cornutus*), swimming in the clear waters before me, and to note also, the movements and colors of some "darters" (*Hololepis erochrous* Cope) that I had caught and bottled. While thus engaged my attention was called to the great tameness of a small hawk (*Accipiter fuscus*). It had evidently been visiting the grass, on which I was now sitting, gathering from it materials for lining a nest which I soon discovered near the top of a high beech tree, not fifty yards distant. When the bird found that I was not disposed to move off, he skimmed away over the meadow and perched upon the fence skirting it. Presently he sailed towards me near the ground and lit by a small tuft of grass. Walking around this he scratched the ground away from the roots, and then seiz-

ing the tuft with one claw, dragged the roots up, and shook off the adherent earth, very much as a man would pull and shake a radish or turnip. Not content with this the hawk now laid the grass upon the ground, combed it out with his beak, and then gathering it up in his bill, flew to the neighboring fence, and hopped along until it found a rail with a narrow crotch in the end. In this it placed the grass, so that the expanded bunch of roots should be on one side and the blades of grass on the other of the notch. When thus arranged to the bird's satisfaction, it again took up the grass in its beak, and giving it a sudden jerk broke the roots from the blades. It then flew to its nest. — CHARLES C. ABBOTT, M. D.

PARTHENOGENESIS IN A WASP. — Professor von Siebold has discovered that in *Polistes Gallica* the males are developed by parthenogenesis, from unfertilized eggs. It will be remembered that in the honey bee the drones are also developed from unfertilized eggs laid by the queen. — *Siebold and Kölliker's Journal of Scientific Zoology.*

LIST OF NEW ENGLAND LEPIDOPTERA. — Mr. S. H. Scudder has published a very valuable and complete list of the butterflies found in New England. I propose to prepare for publication a similar list of the larger Heterocera (Sphingidæ to Phalænidæ inclusive). Any information relating to the times of the appearance of the imagines, or to the food plants of the larva, would be particularly acceptable. Notices, also, of the captures of rare moths or those not strictly part of the New England fauna, and lists of the species taken in any one locality, would afford most important assistance. It would be a great convenience if any one wishing to aid me would communicate any facts to me as early as possible. — CHARLES S. MINOT, 39 *Court Street, Boston.*

IMPROVING INTELLIGENCE IN BIRDS AND INSECTS. — M. Pouchet, the Director of the Museum at Rouen, and a well known naturalist, "has discovered that the new school of swallows are improving their style of architecture, building their nests with more regard to sanitary principles, so as to contain more room and admit more light and air. The shape of the nest is, we infer, more nearly that which will include a maximum of inhabitable space; and, besides this, and still more important, the entrance to it has been changed from a small round hole into a long slit, a sort of balcony, from which the young swallow may look out upon the world and breathe fresh air. What is more, the new school of swallow architects appear to prefer the new streets, while the old school still build the old nests on the cathedrals and older houses; perhaps from some sense of artistic fitness, which scruples at any change of style in adding extensions to monuments so venerable. If this last fact could be satisfactorily established it would furnish a complete answer to the Darwinian theory, so far as it dispenses with intellectual motives for animal progress, and would show a curious amount of æsthetic culture. No doubt migrating birds are of all others least likely to be the slaves of

local prejudices. As the travelled cuckoo was the first to conceive the idea of putting her children out to school among strangers, so the swallow, no doubt, has learned in the south, where air and prospect and space are best appreciated, to adopt the verandah principle, there so universal. Both bees and birds have now been shown to have made great strides in architectural knowledge." "London Spectator," April 16, 1870, in a communication from "Pouchet" in the "Pall Mall Gazette."

A parallel instance in bees is noticed by Dr. Ogle in a very important article on the "Fertilization of Various Flowers by Insects," contributed to the April number of the "Popular Science Review." The arrangements for the cross-fertilization of the flowers of the bean and other papilionaceous plants by bees, here described by Dr. Ogle, are pretty well known, as also the fact that both humble and hive bees have the trick of evading their duty by piercing a hole in the side of the calyx of bean-flowers, so getting at the nectar by a short cut. Dr. Ogle has remarked that while some bees visit the blossom in the natural way, and in so doing take pollen from the anthers of one flower to the stigma of the next, others avail themselves of the shorter cut; but that an individual bee, visiting a succession of bean flowers, uniformly does either the one or the other. It would thus appear that the habit is not an instinct, belonging by inheritance to the whole species, but is in each case the result of individual experience. As with the same experience some bees have acquired the habit and others have not, we must admit, not only that these insects are intelligent, but that they differ from each other in their degrees of intelligence; some being slow in acquiring knowledge, others quicker. The Scarlet Runner, when the bloom is covered with gauze to keep off insects, is wholly sterile; and so indeed habitually are a good many of the uncovered blossoms. The latter is probably owing to the observed fact that most bees have learned to get at the nectary by nipping the tube. Were all bees equally clever there would be an end of scarlet runners, unless indeed either nature or artifice were to induce some modification of structure by which the tube might be protected and the bees again driven to the mouth." We think it proper to add that Dr. Ogle's interesting article is sadly marred and obscured by gross errors of the press, showing that the proofs have not been revised by the author nor by any competent proof reader.

How many Lepidoptera are there in the World? — This question is thus answered by Mr. Bates in his able address to the Entomological Society: — In the "Stettiner Entomologische Zeitung" I find a very readable paper by Peter Maassen, of Elberfield, on a subject which will be interesting to most entomologists. It is an attempt to compute the total number of species of Lepidopterous insects existing in nature, and is written in correction of a previous crude essay by Keferstein on the same subject. In his estimate the author takes for his basis the curious fact that in all complete lists of local Lepidopterous faunas in Europe the

number of moths to butterflies is as twenty-six to one. He then gets at the probable number of butterflies in existence, by arguing from the number published, districts unexplored, and so forth, and believes the number to be not fewer than eight thousand seven hundred and forty. Unfortunately, in pursuing the calculation he forgets his datum-line of twenty-six moths to one butterfly, and takes the proportion as it stands in Staudinger and Wocke's "Catalogue of European Species," where the proportion of course is much less, because the smaller moths have not been so exhaustively collected throughout Europe as the butterflies. In this way he arrives at the total number existing in the world as one hundred and twenty-nine thousand seven hundred and forty — a surprising amount, but still far below the truth if the proportion found in well-worked districts in Western Europe is maintained throughout the world, which would produce the incredible total of two hundred and twenty-seven thousand two hundred and forty species.— *Scientific Opinion.*

Oological. — Two years ago while down here some friends of mine took three eggs from the nest of a red bird (*Cardinalis Virginianus*), and put in their place a Guinea hen's egg. The old bird sat upon the latter about three weeks, and then left. In numbers of nests of this bird found in this state and in Pennsylvania, the number of eggs in the former were invariably three, and in the latter four. Can any one explain this constant difference in the number of eggs? — C. H. Nauman, *Smyrna, Florida.*

Spike-horned Deer. — With regard to the question in discussion between W. J. Hays and Adirondack, whether spike-bucks ever are more than two years old, will you accept the "opinion" of one who has had some experience among deer at the other extremity of our country?

I know nothing of the Adirondack region, personally. I fancy however, it is of small extent: and I suppose it is surrounded by a settled country, peopled for a century or more by a less or greater number of skilled hunters.

Is Adirondack prepared to affirm, without a shadow of doubt, or can he prove to one tinctured with incredulity, that the region actually contains a buck five or six years old? He thinks it easy to distinguish a buck of "full age and size," though destitute of antlers, but gives no marks by which another can judge of the age. I would like to know how he would decide between a remarkably well grown buck of two years, and a runty one of three or four years, in the absence of horns. Among domestic animals may often be seen thrifty yearlings, which will outweigh starvelings of two years or more.

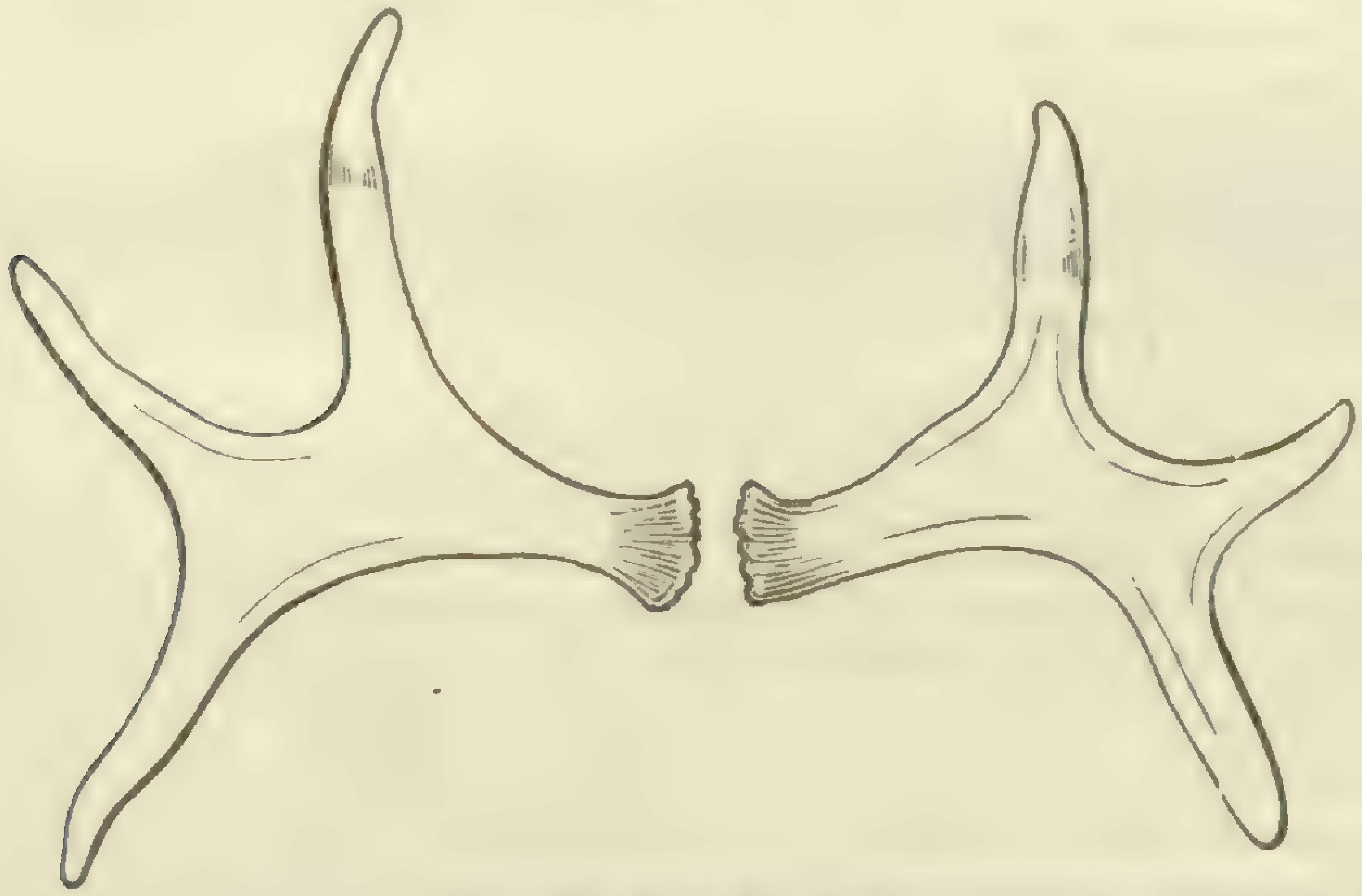
I have killed my hundreds of deer, perhaps — never one spike-buck that would not have been pronounced young by competent judges. I lived with an old hunter who had probably slain his thousands. I never heard him speak of an old buck with unbranched antlers. In my days of deer hunting I associated with many other men more or less acquainted with deer, from none of whom did I ever hear of an *old* spike-horn buck. Can

Adirondack cite from any park an example of such a one whose age is known with certainty? This would be to the purpose.

The explanation given by Mr. Hays seems to be a satisfactory one. The idea that a new race of deer has appeared in that small district within the last few years out-Darwins Darwin. — CHARLES WRIGHT.

A SPIKE-HORNED MOOSE. — Several instances of the capture of "spike-horned" bucks of the common deer (*Cervus Virginianus*), having been recently reported in the NATURALIST (Vol. III, p. 552, Dec., 1869; Vol. IV, p. 188, May, 1870), interest has hence been awakened in respect to this unusual condition of the antlers in the Cervidæ. A "spike-horned" moose, captured in Northern Maine by Mr. J. G. Rich, was recently received at the Museum of Comparative Zoology, of which the accompany-

Fig. 93.



Spike Horns of Moose.

ing figure (Fig. 93) correctly represents the form of the horns, as seen from the front. Mr. Rich writes me that full-grown moose having horns of this character are well-known to the moose hunters of Maine, by whom such animals are termed "spike-horns." Mr. Rich states this animal to have been six or seven years old. Though not a large specimen it was evidently a full-grown one. He says it is believed by the hunters that these animals never shed their horns. The present specimen was taken late in March, nearly two months after the time when these animals usually cast their horns. — J. A. ALLEN.

A NEW INSECT PARASITE OF THE BEAVER. — Herr Krisch has discovered a parasite of the European beaver, which unites the flattened body of the lice, with the peculiarities of the fleas. By the presence of rudimentary wings it is nearest allied to the Diptera, and is named *Platyspyllus castoris*. — *Proceedings of the Natural History Society Isis, in Dresden.*

GEOLOGY.

ANCIENT REPTILES OF THE CONNECTICUT VALLEY. — Professor Cope has noticed in the "American Journal of Science," the bones of the *Megadactylus polyzelus* of Hitchcock found at Springfield, Mass., and infers that they "demonstrate the former existence in the region in question, of a typical form of the suborder, or order *Symphypoda*, and one nearer the birds than any other hitherto found in America." "That animals of this genus made some of the tracks similar to those of birds in the red sandstones of the valley of the Connecticut there can be no doubt," and the author adds that there is abundant reason that they progressed by leaps.

THE RATE OF GEOLOGICAL CHANGE. — Mr. H. M. Jenkins writes on the rate of geological change, in the "Quarterly Journal of Science," and comes to the conclusion that

"Whether we measure the relative lapse of time occupied by the successive events of geological history by the known facts of the accumulation of deposits, or by the comparative changes which have occurred in the life of successive periods, we are led equally to infer that the *rate of geological change* has been more rapid in the latter than in the earlier geological periods, and that that rate has increased progressively from the earliest to the latest times."

MICROSCOPY.

AIR-TIGHT SPECIMENS. — When shall we cease to suffer from the directions sometimes given to mount dry specimens in a cell of pasteboard or paper, fastening the glass cover down by "a little gum" or "paste?" Of course dust or moisture soon accumulates in the cells, or fungoid vegetation grows until it becomes a beautiful and conspicuous specimen; but in any case the original object is tolerably certain to be marred or ruined. I not unfrequently see collections of specimens, by popular makers, which have perished in this manner. Lately I lost in this way a very choice specimen prepared by one of the best European makers, whose work is usually faultless; and still later, having occasion to remount a group of diatoms which had been bought at a considerable price, I found the thin glass-cover supported at its four corners by little pieces of pasteboard, and fastened down by pasting over its edges the handsome paper cover of the slide. I have not yet seen any of Bicknell's beautiful specimens prepared in this slovenly manner, but scarcely any maker seems to be entirely exempt. I know of no cure for this state of things except for microscopists to refuse to buy any specimens, except those mounted in balsam, which are on paper-covered slides. Working microscopists can, and often do, preserve dry objects in cells of paper and pasteboard, an arrangement which is both convenient and economical; but such preparations should always be carefully protected by Brunswick black or some other impervious varnish. — R. H. W.

The Focal Length of Microscopic Objectives. — Mr. C. R. Cross has ably discussed this subject in the "Franklin Journal." He remarks: "The investigation of which the present article is a summary, was undertaken in order to see if some reliable method of measuring the focal length of microscope objectives could not be found. The importance of such a method will be apparent to all who have had occasion to make use of objectives by different makers. The focal length of lenses of the same denomination is subject to so great a variation that comparison of these by means of their assumed focal lengths too often gives no true idea of their relative excellence. For example, if two quarter-inch objectives be compared, and one gives results much superior to that given by the other, we cannot be at all sure that the better lens is not really of shorter focus than its designation would indicate." He presents a table giving "the results of several hundred measurements on various objectives, and suggests that an examination of the table will show that the focal length of the objectives of some makers differs considerably from the length marked upon them. For example, No. 34 marked 1-2 inch is really a 1-3 inch objective; No. 33 marked 1-4 inch is really a 1-5 inch; No. 29 marked 4-10 inch is really a 1-4. Lens No. 14, marked 1-4 inch, is really a 1-5 inch; but Nos. 13, 15, by the same makers, are correctly designated 1-5 inch, 2-3 inch. Differences of this kind must of necessity lead to a great confusion in comparing objectives with one another. I would therefore suggest that each objective made should be measured before being offered for sale, that this confusion may cease to exist. A convenient arrangement would be to fix a glass scale divided to 1-50 or 1-100 inch in the draw-tube, sliding in the tube of the microscope, and measure as I have already described. The draw-tube should be moved till the front of the ruled glass shall be exactly 10 inches from the micrometer used as the object. Or it would be more convenient still to have an apparatus similar to the first form, but arranged with a suitable stage and stand so that it can be set at any desired angle. The distance 10 inches (254mm.), suggested as a standard is chosen because it is the normal distance of distinct vision, as well as about the length used by microscopists in actual work."

ANTHROPOLOGY.

Peruvian Archæology. — The extent to which the conditions of mankind are influenced by natural circumstances, and how these may dictate, not alone the architecture and arts of a people, but their social, religious and political organizations, is perhaps nowhere better illustrated than in Peru. The Inca Empire, it seems to me, was only rendered possible by the peculiar geographical and topographical position occupied by the family or families that were its founders. Long antedating that empire its vast area contained a great number of communities, tribes, or principalities, more or less advanced or civilized, separated from each other,

however, on the coast, by hot and almost impassable deserts, and in the interior by lofty mountains, or cold and trackless *punas*. They had but little intercourse or political dependence, and they all, when by means of alliance or conquest the enterprising families around Cuzco became consolidated, fell an easy prey to those inhabitants of the high, strong fastnesses, or *bolsones*, of the Andes. From their dominating position the Incas were enabled to throw overwhelming forces successively on the isolated valleys radiating from their mountain centre, and one by one mold them into the grandest of aboriginal American Empires. It is easy to see how ambition, and the exigences arising out of their aggressions, should have developed gradually that astute policy or statesmanship, that ability in organization and administration, of which the Incas furnished such a remarkable example.

That portion of the Andean plateau lying between the Pass of La Raya, at the northern extremity of the Titicaca basin and the Pass of la Banda, near Pasco, is a great mountain-encircled region, drained by the River Ucayali, itself, as we have seen, formed by the Vilcamayo, Apurimac, and Pampas flowing north, and the Mantaro flowing south. The beds of these streams are deep and narrow, being merely gigantic canals or drains for the waters collected in numberless vales among the mountains. Nothing better describes these vales than the Spanish word *bolson*, or pocket. And, as I have said, while the valleys of the coast are separated by deserts, these *bolsones* are isolated by ranges of hills, mountains, or uninhabitable *punas*, and all these are divided into groups by the great rivers, which, like the Apurimac, are intransitable except by the aid of bridges of *mimbres*, or ropes swinging dizzily in mid-air.

These *bolsones* are of varying altitudes and consequently of various climates and productions. Some are well-drained, others are marshy, and contain considerable lakes. They discharge their gathered waters, often in large streams that plunge, in numberless cataracts, through dark and narrow ravines into the gorges of the great rivers. The passage from one *bolson* to another is over the intervening elevated ridges and *punas*, frequently among frost and snow, and always by rocky and difficult paths, fit only for the goat and the llama.

It was in precisely one of these *bolsones*, the central one of a group or cluster lying between the Vilcamayo River and the Apurimac, that the Incas built their capital. It is not only central in position, salubrious and productive, but the mountain barriers that separate it from its neighbors are relatively low, and subside into passes that may be traversed with comparative ease, while they are at the same time readily defensible. The rule of the first Inca does not seem to have extended beyond this valley, and the passes leading into it are strongly fortified, with works that face outward, indicating the directions whence attack was possible in the early days of the empire, before the chiefs of Cuzco commenced their career of conquest by reducing the people of the *bolson* of Anta or Xaxiguana on the north, and of Urcos or Andahuaylillas on the south.

The *bolson* of Cuzco, which is not far from thirty miles long, is divided into two nearly equal parts by the Pass of Angostura, or the narrows, where the mountain spurs project toward each other into the valley, leaving hardly room enough for the roadway and the river. On the promontories dominating this narrow passage are the conspicuous ruins of many buildings and remains of works, showing that this was regarded as a strategic or important position, for the immediate protection of the capitol.

The City of Cuzco, which occupies the site of the ancient capitol, stands at the northern or most elevated extremity of the *bolson*, or valley, on the lower slopes of three high hills, the Carmenca, Sacsahuaman, and Cantuta, where as many rivulets, the Almodena, Huatenay and Tullamayo, or Rodadero, coming together like the fingers of an outspread hand, unite to form the Cachamayo, which drains the valley, and falls into the Urubamba. The old city, or rather that part of it dedicated to the royal family, was built on the tongue of land falling off from the hill or headland of the Sacsahuaman, between the Huatenay and the Rodadero.

The position of this city, as determined by Mr. Pentland, is latitude 13° 31′ S., and longitude 72° 2′ W. of Greenwich. Its elevation above the sea, eleven thousand three hundred and eighty feet. Surrounded by high and snowy mountains, it might be supposed to have a cold, not to say frigid climate, but in fact its temperature, though cold, is seldom freezing, and although in the dry season, or what is called winter, from May to November, the pastures and fields are sere, and the leaves fall from all but queñua trees, yet all this is rather from drouth than frost. On the whole the climate is equable and salubrious. Wheat, barley, maize, and potatoes ripen in the valley, and the strawberry, apricot, and peach are not unknown. The climate of Nismes, and of the south of France generally, is much the same with that of Cuzco. When we add to these favorable conditions that not more than thirty miles distant are deep, hot valleys, where semi-tropical fruits may be produced abundantly, we may comprehend that Cuzco was not an unfavorable site for a great capitol.

Its geographical position as regards the country at large, as I have said, was also such as to make it a citadel and the dominating centre of an empire. Its very name, if we may credit the chronicler, signified *Umbilicus*. The Inca power once fairly established in the cluster of valleys, of which I have spoken, and the few and narrow passes by which only they can be reached, strongly fortified, as they were, it was comparatively easy, as I have already said, for the Incas to overwhelm the inhabitants of the long and narrow valleys running down the slopes of the Andes and the Cordilleras, and to subdue one by one the families dwelling in the *bolsones* northward to the Equator, and southward below the desert of Atucama — over an extent of thirty-seven degrees of latitude. — E. G. SQUIER, *from Lecture on Peruvian Archæology delivered before the American Geographical and Statistical Society, February* 15.

ANSWERS TO CORRESPONDENTS.

E. S. Miller. Your specimens reached us in such a decayed condition that it was difficult to recognize them, and after careful study we made out the species as follows: No. 1, *Pontederia cordata*; No. 5, *Ranunculus*, perhaps *R. parviflorus*, but the specimen was insufficient; No. 6, *Lobelia spicata*; No. —, a coarse plant, and is *Lithospermum*; No. —, *Hypericum mutilum*; No. —, *Gratiola aurea*; No. —, *Schollera graminea*. Specimens of plants should be carefully pressed and dried, and never sent fresh, unless intended for cultivation. The deficient numbers were of tickets either destroyed by the heat or fermentation, or torn accidentally on opening the package. We do not want any of the kinds sent as they are common hereabouts, though we thank you for your offer. — J. L. R.

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RECENT ADVANCES IN GEOLOGY.*

BY J. W. FOSTER, LL. D.

Mr. President, and Gentlemen of the American Association for the Advancement of Science:—

THERE is an article contained in our Constitution which requires the retiring President to address the Association in general meeting; and custom has prescribed that he select for his theme some new and important discoveries in science, or some new inventions and processes in the arts.

It is in the discharge of this duty that I appear before you on this occasion, and solicit your attention for the passing hour. So vast is the domain of science, and so numerous have become its cultivators in almost every part of the world, that, even if I had the capacity, the labor of embodying the results of a single year, in a brief address, would be a mere accumulation of details devoid of that spirit which gives them value—generalization.

I shall, therefore, restrict myself to the researches which have been made in those departments of science which with me have been the subjects of special investigation; and shall

* Address of the retiring president of the American Association for the Advancement of Science, J. W. Foster, LL.D., delivered at Troy, New York, on the evening of August 18, 1870.

Entered according to Act of Congress, in the year 1870, by the PEABODY ACADEMY OF SCIENCE, in the Clerk's Office of the District Court of the District of Massachusetts.

seek to set forth what others have accomplished, rather than to advance original views.

It will be found that, throughout all time, since the earth became fitted for the habitation of organic life, that there have been great cycles of heat and cold, and that these cycles have exercised a marked influence in the modification of all terrestrial forms. To traverse the whole ground, would employ too much time; and I shall, therefore, restrict myself to the changes which barely antedate the Human Epoch.

We know that the Tertiary Age, so far, at least, as related to the northern hemisphere, was characterized by a warm and equable climate, extending even to the Polar Sea. Where now blooms the Andromeda close by banks of perpetual snow, at that time grew a luxuriant forest vegetation. McClure's sledging party gathered fragments of fossil wood, acorns, and fir cones in the interior of Banks's Land, far within the limits of the Arctic Circle. As high as latitude 70° N. in Greenland, large forests lie prostrate and encased in ice. At Disco Island, the northern verge of European settlement, the strata are full of the trunks, branches, leaves, and even the seeds and fruit-cones of trees, comprising firs, sequoias, elms, magnolias, and laurels,—a vegetation characteristic of the Miocene Period of Central Europe. Professor Heer particularly notices the *Sequoia Langsdorfii*, which is very closely allied to the *Sequoia sempervirens* of the Coast Range of California.

Spitzbergen was clothed with a forest vegetation equally luxuriant, amongst which the Swedish naturalists recognize the swamp-cypress (*Taxodium dubium*) in a fossilized state, at Bell's Sound (76° N.), and the plantain and linden in King's Bay (78° and 79° N.). The same Sequoia was observed by Sir John Richardson within the Arctic Circle west of MacKenzie River. The lignite beds of Iceland have yielded to the botanists, Steenstrup and Heer, fifteen arborescent forms identical with the Miocene plants of Europe.

In the flora of the Great Lignite Basin of Nebraska, which is referred to the Miocene age, Hayden has detected the oak, the tulip or poplar, the elm and walnut, and a true fan-palm, with a leaf-spread of twelve feet;—all, however, of extinct species. These forms he regards as characteristic of a sub-tropical climate, such as now prevails in the Gulf States. The fan-palm (*Sabal Campbellii*) is the representative of the *Sabal major* of the European Tertiaries, and the *Sabal palmetto* of our Southern States.

The *Cinnamonium*, an unquestioned tropical type, while not thus far detected in the Missouri Basin, has been found by Lesquereaux in the Cretaceous (?) beds of Bellingham Bay, on our Northwestern coast; in the Eocene of the Lower Mississippi, and in the lignite beds of Vermont.

Professor Newberry, in a review of the flora of the Cretaceous and Tertiary Ages of North America, thus remarks:—

"We have, therefore, negative evidence, though it may be reversed at an early day by further observations, that the climate of the interior of our continent, during the Tertiary Age, was somewhat warmer than during the Cretaceous Period; and that during both the same relative differences of climate prevailed between the western and central portions that exist at the present day."

The Drift Epoch was ushered in by a marked change in physical influences, by which the whole flora of the extreme northern hemisphere was so far affected that certain forms were blotted out of existence, while other forms were forced to seek, by migration, a more congenial climate, and accommodate themselves to altered conditions. In the higher regions we find a predominating growth of mosses and saxifrages, and at the southern limits of the Drift a buried vegetation of an Alpine character.

If we examine the faunæ of the two epochs—particularly the land animals which we may suppose to be peculiarly susceptible to atmospheric changes—we shall find that there

was a marked modification of forms. Dr. Leidy, in his late work on the extinct mammalian faunæ of Dakota and Nebraska, states that, of the thirty-two genera of Miocene animals, not one occurs in the Quaternary formation of North America. In comparing the Miocene and Pliocene faunæ with each other, as represented mainly by the remains from the Mauvaises Terres and the Niobrara River, scarcely a genus is common to both. "In view," he continues, "of the consecutive order and close approximation of position of the two formations and faunæ, such exclusiveness would hardly have been suspected." The greater similitude of the Miocene and Pliocene faunæ with the contemporaneous faunæ of the Old World, has led him to suggest that the North American continent was peopled, during the Tertiary Epoch, from the West. "Perhaps this latter extension," he continues, "occurred from a continent whose area now forms the bottom of the Pacific Ocean, and whose Tertiary faunæ is now represented east and west by the fossil remains of America on the one hand, and of Asia, with its peninsula, Europe, on the other."

The topographical features of the two continents and the hydrographical soundings of the two oceans, render this supposition probable. Between Ireland and Newfoundland there is a great plateau, which an elevation of the earth's crust to the extent of a few thousand feet would convert into dry land; and Behring's Straits, which now separate Asia and North America, are, at their narrowest points, but thirty miles wide, and their shallowest depth is but twenty-five fathoms.

And here the palæontologist comes to the aid of the hydrographer, and, by their joint labors, the one renders probable what the other has conjectured as possible—the former union of the two hemispheres. Zoology would indicate that such was the fact during the Pliocene Epoch, in which will probably be found the origin of those mammalian types contemporary with the elder man, and represented by

the extinct Proboscidians and Ruminants. None of these large animals could probably have passed over the straits which now divide these regions, and the close alliance in form would indicate a common origin. We infer, therefore, that the subsidence during the Drift Epoch cut off the communication between the two hemispheres, and the refrigeration which then took place, served to disperse the colossal animals, who sought by migration to lower latitudes a climate congenial to their nature.

As in Europe we find the remains of these northern types intermingled with those of an African type — the hippopotamus, which in his summer migrations strayed as far north as England; so on this continent we had, during this epoch, the great sloths, represented by the megalonyx and mylodon, whose congeners at this time exist in South America. Thus there was an inosculation, so to speak, of two distinct and contemporaneous faunæ.

It is an inquiry of the highest interest — perhaps as much so as any connected with the physical history of the past: How far has man been a witness of these stupendous changes? It is not until towards the close of the Drift Epoch, that we are enabled to detect unmistakable signs of his works, although there are not wanting proofs which would refer his origin to an earlier date — the Pliocene. So numerous and well-attested are the facts, that we must now regard him as the contemporary of many of the great mammals which have ceased to exist, and the subject of physical conditions very different from what now prevail. To account for these changes requires the lapse of a longer period of time than has heretofore been assigned to his existence upon earth.

Thus within a few years has been opened a sphere of investigation which has enlisted a large class of able observers, and their labors have thrown a flood of light upon the origin of our race. Ethnography has become aggrandized into one of the noblest of sciences. However conflicting these revelations may be to our preconceived notions, they

must not hereafter be disregarded in treating of the past and present condition of humanity. We must weigh the value of observations and press them to legitimate conclusions. The investigator at this day is not to be trammelled, in the language of Humboldt, by "an assemblage of dogmas bequeathed from one age to another"—by "a physical philosophy made up of popular prejudices."

The periods of the prehistoric man have been divided by M. Lartet, into two ages:—

1. The Stone Age, and (2) the Metal Age.

The Stone Age has been subdivided into three epochs.

1. That of the extinct animals, such as the mammoth and cave-bear.

2. That of the migrated existing animals (Reindeer Epoch).

3. That of the domesticated existing animals (Polished Stone Epoch).

The Metal Age has been divided into two epochs:

1. That of Bronze, and (2) that of Iron.

The elder man differed widely from the intellectual and much-planning man of this day. The conditions of climate greatly modified his modes of thought and physical pursuits. The northern hemisphere was just emerging from a long-continued state of glaciation. The snows which had wrapped the earth as in a mantle, were melting, and the great glaciers were reluctantly retreating within the Arctic Circle. Every depression became a lake, and every lake a sea for the reception of the accumulating waters, whose resistless force swept along mud, and sand, and shingle, and fragments of rocks. As the barriers gave way, the waters cut out channels on their route to the sea, and the terraces and ridges which border our lakes and rivers are but the monuments of their erosive action. It was a sad and desolate land, to be paralleled only in the Arctic Circle. But man was not alone. On the European Continent there was a strange assemblage of animals; the elephant, with his

compound clothing of wool and hair; the rhinoceros similarly protected; the cave-bear and cave-hyena; the tiger; and the great ox, not patient of toil as at this day, but fierce and indomitable. On this continent was the elephant of a closely-allied species; the lion and bear, and at least two species of the musk-ox, gigantic as compared to their modern congener.

In such a climate and on such a soil we can well imagine that agriculture formed no part of the occupation of the primitive man. He gathered not the kindly fruits of the earth, but was essentially a predaceous animal. The few skulls that have been recovered would indicate that he was low in the scale of intellectual organization—a small brain, a retreating forehead, and oblique jaws. In capacity he was below the Australian and New Zealander. In stature he was dwarfed, but was broad-shouldered and robust—the result, perhaps, of vigorous exertion and out-door exposure. He was carniverous, and, perhaps, a raw flesh-eater; for in the jaws which have been disinterred, the incisor-teeth are much worn—a peculiarity which has been noticed in those of the flesh-eating Esquimaux. This fact ought not to be cited to his disadvantage, for in an Arctic climate, where the animal heat is so rapidly abstracted, man requires a highly nitrogenous food. Thus we find our own countryman, Kane, when imprisoned in the ice of Rensselaer Harbor, resorting to raw walrus-meat, and rolling it as a sweet morsel under his tongue.

It cannot be gainsayed, however, that man was a cannibal. In Scotland were found the bones of children which, according to Owen, bore upon them the marks of human teeth, and the evidences produced in the Archæological Congress at Copenhagen established this fact beyond controversy. He was not destitute of skill in the art of delineation, for we have restored to us, on a slab of slate, a very good profile of the great cave-bear—the earliest instance extant of pictorial representation.

But we must accord to him one redeeming trait. That homage which, in all ages and among all nations, the living pay to the dead; those ceremonies which are observed at the hour of final separation; that care which is exerted to protect the manes from all profane intrusion; and those delicate acts, prompted by love or affection, which, we fondly hope, will smooth the passage of the parting spirit to the happy land—all these observances our rude ancestors maintained. These facts show that, deep as man may sink in barbarism, brutal as he may become in his instincts, there is still a redeeming spirit which prompts to higher aspirations, and that to him, even, there is no belief so dreary as that of utter annihilation.

Perhaps, among the existing tribes of the human race in the Arctic Highlander, as described by Sherard Osborn, we have the nearest approach to the prehistoric man:—

"Although dwarfed in stature, they are thick-set, strong-limbed, deep-chested, and base-voiced, and capable of vigorous and prolonged exertion. * * I cannot discover an instance of their ever having been seen to partake of a single herb, grass, or berry, grown on shore. Of vegetables and cereals, they have of course no conception, and I know of no other people on the earth's surface, who are thus entirely carniverous."

After the lapse of a period whose interval cannot be measured, the great animals which characterized the dawn of the Human Epoch, began to disappear, and were replaced by other forms of diminished size, but of improved type. Among these, on the European continent, were the reindeer, the musk-ox, the stag, the bison, and urus, together with the horse, not distinguishable from the existing species. The reindeer and musk-ox, which only thrive in a cold climate, not only occupied England, but wandered as far south in France as the shores of the Mediterranean and the slopes of the Pyrenees, which interposed effectual barriers to their further progress.

The reindeer must have existed in vast herds, and to the primeval man have proved the most useful of animals.

Every portion of the carcase was economized. His flesh furnished food; his skin, clothing; his sinews, thread; and his horns were fashioned into harpoons, javelins, and sockets for the reception of spearheads and hatchets.

On this continent we find the musk-ox and reindeer, identical in species with the European forms, in a fossilized state. The reindeer ranged as far south as Kentucky and New Jersey, but the existing musk-ox has not been found fossilized outside of his present limits. The Böotherium, however, which exceeded him in size, and to which he was closely allied, had a range co-extensive with the reindeer. The stag (*Cervus alces*) and the bison (*B. latifrons*), were in existence, while the horse, which is abundantly represented in the Pliocene, and is continued into the Quaternary Period, had become extinct before the discovery of America. His remains are found in Eschscholtz Bay (latitude 66° 20′ North) in connection with those of the *Elephas primigenus*, the urus, deer, and musk-ox, embedded in a deposit of clay and fine micaceous sand. The rhinoceros (*R. merianus*) appears in the Miocene of Texas, and is represented in the Pliocene of the Upper Missouri as *R. crassus*, and in the same formation in California as *R. hesperius;* but thus far the *Rhinoceros tichorhinus* so intimately associated with the great Proboscidians of Europe, has not, to my knowledge, been found in North America. In addition to these forms may be mentioned the great mastodon, which came into being subsequent to the elephant, and survived his extinction.

The fact of the existence of the mammoth or mastodon, was certainly known to the founders of the cities of Central America, for in more than one instance there is graven with elaborate care, on the walls of their structures, the form of a Proboscidian, which cannot be mistaken for one or the other of these animals; but the works on which these delineations are made, indicate a far higher order of art than was ever attained by the prehistoric man of Europe. These

delineations, I am disposed to think, are of the mastodon, and, found as they are upon the walls of stone-built palaces and temples, there is strong evidence to believe that this great Proboscidian survived almost to the Historic Period.

The men of the Reindeer Epoch made gradual advances in the industrial arts. They did not cultivate the soil, for the climate was still inhospitable. While their progenitors were content with knives flaked from flints in the form of rude fragments with cutting edges, they wrought out tools more symmetrical, but without any attempt at polishing.

They attained to a very creditable degree of artistic skill, as shown by their designs traced on tablets of ivory, and carved out of the antlers of the reindeer. We have thus represented the stag, the ibex, the horse, a reindeer couchant forming a dagger-hilt, and also the great elephant with his characteristic markings; the small oblique eye, the ponderous trunk, the recurved tusks, and the shaggy mane. The human form even is delineated. We have an ivory statuette of the female figure, and traced on a stag's horn the outline of a male figure with a caudal appendage like that which was conjectured by Lord Mondoddo, the eccentric Scotch philosopher, to appertain to the primitive man.

On this continent the evidences of the existence of man at this age, while obscure, are yet, I am disposed to believe, authentic. The human bone found in the Loess at Natchez, and the flint implements found in connection with the Missouri mastodon, may claim as high an antiquity as the oldest of the European "finds."

The discoveries in California would seem to carry back the existence of man to a remote date. As far back as 1857 Dr. C. F. Winslow sent to the Boston Natural History Society a fragment of a human cranium found in the "paydirt" in connection with the bones of the mastodon and elephant, one hundred and eighty feet below the surface of Table Mountain, California. It was in this region (Angeles, Calaveras County) that a human skull was subsequently found

by a miner named James Matson in a shaft one hundred and fifty feet deep, which passed through five beds of lava and four deposits of auriferous gravel. The statements of Professor Whitney as to the authenticity of this skull have been received with extreme distrust; but does not this earlier discovery of human remains in the same formation confirm the correctness of those statements?

Our country is yet new, and it is only recently that attention has been directed to these investigations. It is hardly to be expected that a competent observer will be present at the precise time when any relic of the past is disinterred; and there is an universal feeling of doubt and distrust as to the authenticity of all such finds. With the evidence before us that both hemispheres have been subjected to the same dynamic causes, and peopled by the same races of animals, often identical in species, is it not philosophical to infer that here we shall be able to detect the traces of man and his works, reaching back to as high an antiquity as on the European continent?

The Reindeer Epoch terminates the earliest known record in the career of man. It was signalized by a series of physical events too important to be slightly passed over. The glaciers again advanced, and again the land became refrigerated; but the cold period was not so long continued, and was less intense. To this succeeded a period of warmth, and as the glaciers dissolved under its influence, there ensued a flood which swept over the lowlands and forced the cave-dwellers to flee to the high grounds. The water in Belgium, according to Dupont, rose to the height of four hundred and fifty feet, and the calcareous mud, known as the Loess, was then deposited in the Rhine Valley. The caves were also invaded, and the "bone-earth" which forms the division between two distinct faunæ, is of the same age.

It was during this epoch that the great mammals disappeared from the earth; the elephant, the rhinoceros, the cave-bear, the cave-hyena, the tiger, and the Irish stag.

The reindeer, the musk-ox, and the elk, migrated to the north where the changed conditions of climate were more congenial to their nature.

The musk-ox has disappeared from Europe, but he survives on this continent, restricted in his range to what are known as the "Barren Grounds," lying between the Welcome and Coppermine mountains. The auroch, protected by stringent laws, still survives, while the horse, domesticated by man, has vastly multiplied. The ure-ox, living through the great catastrophe, has disappeared within historical times.

The greatly augmented thickness of the Loess on this continent, would indicate that the ice action was exerted more powerfully, and its effects are traced over a larger area; and the same destruction overtook the larger quadrupeds, extending even to the gigantic sloths, who lived in a milder climate.

From this era we may date a change in the physical conditions of our planet, so far at least as relates to the northern temperate zone. The climate became milder, and the soil yielded more bountifully those seeds and fruits which contribute to human support. Man for the first time began to show signs of progress in the industrial arts. His weapons of flint were more symmetrically fashioned, and in some instances were polished. The dog became his companion, and some of the other animals were domesticated. This was the Polished stone Epoch.

In the Bronze Epoch we trace still greater advances. Man dwelt in fixed habitations. He surrounded himself with such domestic animals as the ox, horse, pig, goat, and sheep, and retained his companionship for the dog. He cultivated wheat and barley, whose flour he kneaded into bread and baked between heated stones. Apart from berries he gathered the fruits of the pear, cherry, and plum. The discovery of the art of smelting copper, and of the additional art of hardening it by a slight admixture of tin, was an immense

stride towards civilization. Ere long followed the discovery of the art of iron-smelting, — a discovery which has done more to advance the welfare of our race than all others combined. Then it was that man, for the first time, was furnished with a weapon which enabled him to achieve a conquest over Nature, and this assertion will not appear extravagant when we reflect how intimately this metal is connected with all the industrial arts.

The Iron Epoch approaches so near the Historic Era, that, as forming a portion of geological history, the events are too insignificant to be dwelt upon.

The Mound-builders of our own country, in the scale of civilization, were intermediate between the Polished stone and the Bronze Epochs of Europe. They resided in towns, many of which have since become the sites of flourishing cities. They practiced agriculture, making use of maize as their chief cereal; but there was not on this continent a domestic animal who could aid them in their labors or contribute to their sustenance. Strange as it may seem, that while the Danish kitchen-middins and the Swiss refuse-heaps contain abundant traces of mammalian bones, thus far they have been but rarely detected in the mounds. They chipped with great skill the limestone-chert into spades, spear-heads and arrowheads. Out of porphyry or greenstone they wrought their hatchets and battle-axes, and these were often ground and polished. The same material, too, was often used in making pipes, which were carved into forms representing quadrupeds and birds, so faithful in detail that the species to which they belonged can be identified. The specular iron-ore of Missouri was elaborately wrought and polished into slung-shots or "plummets." They mined extensively the native copper of Lake Superior, which they beat, and perhaps smelted, into knives, chisels, spearheads, arrowheads and bracelets. They wove cloth with a regular warp and woof, out of a fibre as yet undetermined. They modelled clay into vases, water-coolers, and other utensils,

and ornamented them with elaborate designs, and the human face, even, is portrayed with rare fidelity; and finally, they must have maintained an intercourse with distant and widely separated portions of the continent.

Since the close of the Reindeer Epoch the changes which have taken place in the flora and fauna of Europe have been slight. We may note, however, the disappearance of the Scotch fir (*Pinus sylvestris*) from Denmark, where it is found entombed in the peat-swamps, and the introduction of the sessile oak, which in turn is becoming supplanted by the common beech. In the Baltic the oyster flourished in places from which it is now excluded, and certain other marine forms that attained a full growth, are now dwarfed. There is an instance or two of the disappearance of mammalian forms, but this may be traced to the direct agency of man. These slight changes in physical geography have modified the distribution of animals and plants, but they have not affected, in the least, their form. Whatever changes have been observed are due to domestication.

So far as relates to our own country, there are evidences in the Great Basin and on the Colorado Plateau, that at no remote day there was a much more genial climate and a soil more productive than now prevail. This is seen in the dead forests that line the mountain side; in the waterlines of the lakes and streams high above the greatest floods; deep cañons through which now course trickling streams, but which must have formed the channels of voluminous rivers; and alluvial bottoms now bare and desolate, in which are imbedded a robust vegetation.

I have, perhaps, dwelt too long upon these changes which have so essentially modified the surface of the earth, and at the same time the destinies of our race. Had an Arctic climate continued to prevail over what is now the temperate zone, man would have made no advance in civilization; life to him would have been a continued struggle for existence. It is only in a genial climate, and on a soil so generous as to

yield with moderate exertion a support, that he can cultivate his intellect; and such culture, I need hardly affirm, is at the base of all civilization.

How great the contrast between the primitive cave-dweller and the practical man of to-day, who, availing himself of the conquests of science, subjects the forces of Nature to his will; who spans with bridges, deep chasms; who stretches his iron rails over high summits; who traverses the trackless deep with unerring course; who flashes intelligence over a hemisphere. How different from the intellectual man of to-day, who weighs the earth as in a balance; who measures the distance of the sun and assays its elements; who maps the comet's path; who penetrates the deepest mysteries of the Universe. The one was almost a brute; the other is almost a god!

While these revolutions have taken place on the surface of the earth they have, at the same time, been sufficiently powerful to modify the marine fauna in the disappearance of old and the introduction of new forms to the depth of 1,500 feet; but in the profounder abysses of the ocean, age after age, the conditions of life have remained comparatively unchanged. It is only within the past year that this interesting fact—a fact which must lead to a material modification of our previously formed views—has been prominently developed.

The soundings made as far back as 1857, over the great telegraphic plateau which stretches from Valentia to Newfoundland, disclosed in all instances a fine calcareous mud which entombed countless millions of shells belonging to the family of *Rhizopods*, and some peculiar bodies which are known as *Coccoliths* and *Coccospheres*, which were found to correspond with the organic contents of the true Cretaceous Period. In 1861, among a number of living mollusca and corals found adhering to a telegraphic cable between Algiers and Sardinia, taken up for repairs, Milne-Edwards detected certain shells which were only known as Tertiary fossils. In

the same year Sars, the Swedish naturalist, described the *Rhizocrinus Lofotensis*, obtained on the Scandinavian Coast, a new and living type of Crinoidea belonging to a family characteristic of the Oolite. The soundings, prosecuted under the direction of Count de Pourtales, attached to the United States Coast Survey, between Florida and the outer edge of the Gulf Stream, have yielded important results which have been in part reported upon by de Pourtales, the elder and younger Agassiz, and Lyman.

The deep-sea dredgings prosecuted during the past year on board of her Britannic Majesty's ship Porcupine, placed at the disposal of a scientific committee, consisting of Messrs. Carpenter, Jeffrys, and Thompson, have yielded results of the highest interest. The supposition of an Azoic zone must now be abandoned. The profoundest depths of the ocean, in which the Himalayas or the Andes might be engulfed, are now believed to be inhabited, and inhabited, too, by organic forms which, since the dawn of the Cretaceous Age, have undergone no considerable modification. The littoral deposits, on the other hand show the most marked diversities in organic forms. In one sense, as declared by Dr. Carpenter, we are living in the Cretaceous Age; in another, since the close of that age we have witnessed repeated dispersions and modifications of organic forms.

Dr. Wyville Thompson, generalizing on these facts, says that there is no direct evidence that oscillations have taken place in the Northern Atlantic greater than 1,500 feet since the commencement of the Mesozoic Period, and that the great depressions in the Pacific and Atlantic oceans are due to causes that acted before that period.

"There have been," he continues, "constant minor oscillations; but the beds formed during periods of depression, but now exposed by an upheaval of this minor character, are comparatively local and shallow-water beds, as shown by the nature and richness of their fauna."

The dredgings which have been made in the fresh-water

lakes of high northern latitudes have proved of equal interest. In the Swedish lakes, Wetersee and Wenersee, have lately been discovered crustacea which, though differing from those now living in the sea, are clearly related to marine forms of a northern and even Arctic character. Thus have been found the *Mysis relicta*, whose congeners live altogether in the sea, and those resembling the species in the most northern latitudes; the *Gammarius loricatus* thus far found only in the Arctic Ocean, Baffin's Bay, Greenland, and Spitzbergen; the *Idothea entomon*, in the Arctic Ocean and the Baltic Sea; and the *Pontoporcia affinis*, still found in the Baltic, but whose related species occur in the Greenland seas. These lakes are three hundred feet above the sea-level; but these results show that at no remote day they communicated with the ocean, and were originally tenanted by a marine fauna of an Arctic type. As these waters became first brackish and then fresh, most of the forms died out during the transition, leaving in the depths a few crustacea which correspond in part to the species in the Baltic, and in part to those of the Arctic Ocean.

Within the past year Dr. Stimpson has obtained results equally interesting, from dredgings brought up from the deeper parts of Lake Michigan. The lake-level is five hundred and eighty-three feet above the ocean, and the greatest depths extend below that line. At the depth of sixty fathoms he obtained a *Mysis* which, although not specifically identical with the Swedish form, is closely allied, and its occurrence authorizes us to draw the same conclusions as to the marine character in former times of the Great Lakes, which the Swedish physicists have arrived at as to the former condition of their own.

Much discussion has been had in former years, and even in this Association, as to the nature of these lake waters during the Glacial Age. It is well known that on the borders of Lake Champlain, and at intervals along the St. Lawrence from Quebec to Kingston, and up the Ottawa, the terraces

attaining an extreme height of between four hundred and five hundred feet, contain marine remains; but when we pass over into the Great Lake-basin, these remains disappear. Hence it has been inferred that, at that time, as now, the Great Lakes were filled with fresh water; but the discoveries of Dr. Stimpson, I think, disprove the correctness of this inference; and further discoveries may show that these lakes formerly had communication, not only with the Atlantic through the St. Lawrence, but with the Arctic Ocean through Hudson Bay.

We are now led to the inquiry: What has caused these great changes of temperature, affecting the whole economy of terrestial life? Between the Arctic an Antarctic regions, there are great diversities of climate and physical conditions. The one is characterized by a vast expanse of land, and the other by a vast expanse of ocean. The one enjoys a short-lived summer in which the flowers blossom and fructify; in the other reigns unmitigated winter, and even mosses and lichens are absent. In the one the reindeer and musk-ox are hunted to the verge of the sea; in the other, animal life disappears below latitude 56 deg. Man has been able to penetrate North to 82 deg., 40 min., 30 sec., or within nearly five hundred miles of the pole; but to the south he has only reached 78 deg., 10 min., or about eight hundred and fifty miles.

There are several causes which combine to produce this result. The great continental masses which characterize the northern hemisphere, warmed by the summer sun, radiate heat into surrounding space, while the narrow expanse of land in the Antarctic circle, bathed by chilled waters, and encased in ice, acts as a refrigerator of the atmosphere. Besides, as we shall hereafter show, owing to the earth's movement, the southern summer is shorter by at least eight days, and the amount of heat received during that period by the northern hemisphere cannot but exert an appreciable influence. The Arctic region, then, enjoys a milder climate than

it would if, as in the Drift Epoch, it were submerged to the depth of at least two thousand feet. In the Great Year of astronomers, the southern pole, after having passed through its great winter solstice, is now entering upon its summer climate.

Lyell has conjectured that these phenomena are due to a different distribution of land and water, combined with a different distribution of oceanic currents; but with an expanse of land occupying almost the whole of the northern hemisphere, and with the Gulf-stream diffusing its warm breath over the western coast of Europe, and the Japan Current over the western coast of America, we find that the domain of ice and snow remains fixed; and we can conceive of no conditions, dependent upon these causes, whereby the *Cinnamonium* should again flourish at Bellingham Bay, or the *Sequoia* on the Greenland coast.

Others have inferred that these great cycles of warmth and cold may be due to the increased or diminished heat transmitted from the interior of the earth. If we adopt the theory of a cooling globe, there must have lapsed a very considerable period between the time when it passed from an incandescent state and when it became fitted for the sustenance of organic forms. Sir William Thompson, basing his observations on the well known laws of heat and conservation of energy, infers that it has only been habitable within the last one hundred millions of years. It is, then, if his estimates be true, that within this interval we are to include all the changes in the organic world — the floræ and faunæ which have successively come into being, and have successively displaced each other.

In the process of solidification the earth is supposed long ago to have arrived at that stage when the radiation from the cooling surface is no greater than that derived from the sun, and therefore, a stable temperature has been established. We would infer, then, that any violent reaction of the interior upon the external crust, would affect more sensibly the

deep-sea animals than those dwelling on the land; but the investigations which I have cited, show that while the sea-fauna has undergone slight modifications since the dawn of the Cretaceous Epoch, the land-fauna has been subjected to the most marked deviations.

May not, then, these fluctuations of temperature be due to causes which operate from the exterior? It is necessary to assume that, throughout the lapse of all time, our planet has occupied its present relation to the sun, or the solar system? Is not the recession of Sirius, which is now going on, an argument against the fixity of the siderial heavens?

We are assured that ours is not a central sun, but one in the great possession of stars which is sweeping towards the constellation Hercules; and that in the region of either there are spaces of densely-clustered stars, and other spaces which are comparatively barren. Now every star is a sun, emitting light and heat, a portion of which is transmitted to us. Our planet at this time is moving through one of those starless spaces, and therefore is not in a position to receive the full influence of such a cause. The distinguished Swiss botanist, Heer, to whom we are so largely indebted for our knowledge of the Miocene flora, has suggested that it is to this source rather than to telluric causes we are to resort to explain the varying distribution of temperature as manifested in past geological times.

Again: Have we the right to assume that, throughout all past ages, the poles of our planet have pointed in the same direction? We can conceive that, if its axis were to form with the plane of the ecliptic, the same angle which it now forms with the equatorial plane, there would ensue an entire change of climate, and consequently of organic forms. Why should the astronomer insist on the immutability of the siderial system, when to the geologist is unfolded a record of seas displaced and continents elevated; of great cycles of heat and cold; of the disappearance of old, and the appearance of new forms of organic life? Change, not constancy, is inscribed on every leaf in the volume of Nature.

I am not a believer in the doctrine of multiplied shocks. I would not, in the explanation of natural phenomena, resort to blind catastrophes. But is there not behind all, and over all, and pervading all, a great governing principle to whose operation we can refer these changes? Does it not exist in the celestial mechanism itself? To the solution of this problem the attention of several physicists has been directed.

The speculations of the French savant, Adhèmar, are not altogether to be overlooked, based as they are on the precession of the equinoxes and the movement of the apsides; a movement which, I believe, was unknown to the elder astronomers. If we compare the movement of the earth with the stars, it requires the lapse of 25,000 years to bring the equinox to correspond with the same point in space it now occupies; but the orbit itself being movable, this period is reduced to about 21,000 years. This is called the Great Year, being the measure of time before the winter solstice will again exactly coincide with the *perihelion*, and the summer solstice with the *aphelion*, and before the seasons will again harmonize with the same points of the terrestrial orbit.

The earth, at this time, approaches nearest the sun in the northern hemisphere during autumn and winter, and it is only when it recedes the farthest from the source of heat that the northern hemisphere receives the full effect of its vivifying warmth. As the earth between the vernal and autumnal equinox traverses a longer circuit than during the other half of the year, and also experiences an accelerated movement as it draws near the sun, the result is, that the northern summer is longer than the southern by about eight days; but after the lapse of ten thousand five hundred years these conditions will be reversed. It was in the year 1248, according to Adhèmar, that the Great Northern Summer culminated, since which time it has continued to decrease, and that decrease will go on until the year 11,748, when it will have attained its maximum.

This compound movement, the precession of the equinoxes and the shifting of the line of apsides, it is claimed, exerts a marked influence in the distribution of the earth's temperature. While the Great Winter prevails at the north pole, the refrigeration is so excessive that the heats of summer are insufficient to melt the snow and ice precipitated during the winter, and hence, year after year and century after century, they go on accumulating, until the circumpolar region is in a state of glaciation, and the added weight becomes sufficient to displace the centre of gravity, which would be equivalent to a subsidence at one pole and an elevation at the other. M. Adhèmar has even calculated the extent of this movement, and states that it would amount to about 5,500 feet. Now, let it be borne in mind that Professor Ramsey has shown that in Wales the submergence of the land during the Drift Epoch amounted to 2,300 feet, and our own observations show that in the northern portions of this country the glacial action proper may be traced to the height of 2,000 feet; although there were mountains which served as radiating centres, on whose flanks the Drift action may be traced much higher. These geographical points, roughly estimated, are about midway between the equator and the pole, and the extent of the subsidence would correspond very well with the calculations before referred to.

In the year 1248, the Great Winter terminated at the south pole, where for 10,500 years the accumulation of snow and ice had been going on, attended with the phenomena which we have described. "Here then," says M. Julien, an advocate of this theory, "is an irresistible force which, following the invariable law of the irregular precession of the equinoxes, must make the earth's centre of gravity periodically oscillate."

Mr. Croll, an English physicist, has elaborately discussed this question in a series of papers in the "Edinburgh New Philosophical Magazine," which have excited profound attention. With great labor he has prepared tables showing the

amount of the earth's eccentricity for the period of three millions of years, at intervals of 10,000 years for a greater portion of that time, and 50,000 years for the remainder. He infers that a glacial period occurs when the eccentricity of the earth's orbit is at a maximum, and the solstices fall when the earth is *in perihelio* and *in aphelio;* and that only one hemisphere has a glacial climate at the same time, which occurs when the winter is *in aphelio.*

In this connection I may mention the labors of our own countryman, Mr. Stockwell, who has prepared a paper, now on file in the Smithsonian Institution, embodying his own calculations as to the earth's eccentricity for the past two millions of years.

There is such an intimate connection between the several branches of science that the researches in one field often throw light upon the obscure points in another. In the solution of this difficult problem, the geologist may invoke, and I trust not unsuccessfully, the aid of the astronomer.

That a set of causes were active during the Drift Epoch, in one hemisphere, which remained dormant in the other, admits of little doubt; and the advocates of the astronomical theory, as evidences of the shifting of vast amounts of water from one pole to the other, point to the marked differences in the topographical features of the two hemispheres. In the Austral region we meet with projecting headlands and peninsula-like terminations of continents, and groups and chains of islands in the Pacific and Indian oceans extending over vast areas, which rise up like the peaks and crests of mountains. These are the evidences of a gradually engulfed hemisphere. In the Boreal region we have wide expanses of land diversified by mountains, prairies, and plains; elevated sea-beaches and river-terraces, most conspicuously displayed on the borders of the Arctic Sea; vast oceanic shoals; a marine fauna of a northern type preserved in beds of 1,400 feet, and stratified beds of gravel and sand 2,000 feet, above the ocean-level; clusters of lakes yet re-

taining their bitter waters; shallow seas once salt, but each decade becoming more brackish; vast desert tracts which up to a recent time formed the ocean bed;—all these phenomena indicate a hemisphere gradually emerging from the waters. Perhaps the physicist can discern in these great periodic oscillations, the method by which Nature perpetually renews the youth of our planet, and maintains its fertility.

Gentlemen of the American Association: — The hour which, in your courtesy, had been assigned to me, has now lapsed, and I must bring these remarks to a close. The topics which have passed under review open up spheres of thought with regard to time and space too vast to be compressed within the limits of a mere oral discourse. Asserting no ability by reason of profound research to pass authoritatively on these results, may I not inquire: Have they not disclosed new paths in the great domain of Nature, which may be profitably explored jointly by the geologist and the astronomer; and is there not a probability that there will be found to exist an intimate relation between the periodic fluctuations of temperature on our planet, and the periodic pertubations to which it is subjected as a part of the solar system? Great as have been our achievements in science during the past, we profoundly believe that new triumphs await the patient observer.

VARIATIONS IN TRILLIUM AND WISTERIA.

BY THOMAS MEEHAN.

In a recent number of the "Bulletin of the Torrey Botanical Club," of New York, Mr. J. H. Hall describes a plant of *Trillium erectum*, which he has had under his observation for several years, and which produced some years white, and other years the regular brown purple flowers. I have made

a similar observation this year in a *Wisteria sinensis.* Plants on my grounds have made an unusual second flowering. There were more blossoms in July than in April. Among them is a *snow white* variety, which has flowered annually for six years past at least. At this second flowering it took a notion to flower *blue,* — not quite as deep a blue as the regular tint of the well known kind; but still anything but the white we have always had before. It was very difficult for my gardener to believe that in some way or another "some hybridization" had not been going on. Potatoes frequently change this way in the color of the tubers, when the intelligent farmer is sure "there must have been some mixing of the pollen which in *some way* affected the circulation and changed the color." Dahlias, chrysanthemums, balsams, and many other things with parti-colored flowers, frequently have some wholly of one of the mixed colors; but all this in *some way* is supposed to be the work of art.

These natural variations I regard with much interest as teaching us that the law of evolution is not wholly through seed, and that those botanists who look for it in the embryology of the reproductive organs are not wholly on the right track.

Physiologists usually commence their treatises with "the seeds;" as if the seed was the primary element in the organization of vegetation, instead of the final result. Not that they really teach it, but this order of treating the subject gives the public mind that impression. Mr. Darwin's ideas seem to arise from some such reasoning as this. It seems hardly possible to conceive of first existences from eggs or seeds. True we see most of the changes through this medium *now;* but if we find cases in abundance (and I think we might if we looked for them) like these of *Trillium* and *Wisteria*, where changes occur independently of sexual influence, they will at least suggest another law to account for the origin of species.

THE PRIMITIVE VEGETATION OF THE EARTH.

BY J. W. DAWSON, LL. D.

Twenty years ago scarcely anything was known, even to those engaged in the study of vegetable fossils, of a land flora older than the great coal formation. In 1860, Goeppert, in his Memoir on the plants of the Silurian, Devonian, and Lower Carboniferous, mentions only one land plant, and this of doubtful character, in the Lower Devonian. In the Middle Devonian he knew but one species; in the Upper Devonian he enumerated fifty-seven. Most of these were European, but he included also such American species as were known to him. The paper of the writer on the Land Plants of Gaspé was published in 1859, but had not reached Goeppert at the time when his memoir was written. This, with some other descriptions of American Devonian plants not in his possession, might have added ten or twelve species, some of them Lower Devonian, to his list. In the ten years from 1860 to the present time, the writer has been able to raise the Devonian flora of Eastern North America to one hundred and twenty-one species, and reckoning those of Europe at half that number, we now have at least one hundred and eighty species of land plants from the Devonian, besides a few from the Upper Silurian. We thus have presented to our view a flora older than that of the Carboniferous period, and, in many respects, distinct from it; and in connection with which many interesting geological and botanical questions arise.

Geologists are aware that in passing backward in geological time from the modern to the Palæozoic period, we lose, as dominant members of the vegetable kingdom, first, the higher phænogamous plants, whether exogenous or endogenous; and that, in the Mesozoic period, the Acrogens, or

higher cryptogams, represented by Ferns, Club-mosses, and Equiseta, share the world with the Gymnosperms, represented by the pines and Cycads, while the higher phænogams on the one hand, and lower cryptogams on the other, are excluded. Hence, the Mesozoic age has been called that of Gymnosperms, while the Palæozoic is that of Acrogens. These names are not, however, absolutely accurate, as we shall see that one of the highest forms of modern vegetation can be traced back into the Devonian; though the terms are undoubtedly useful, as indicating the prevalence of the types above mentioned, in a degree not now observed, and a corresponding rarity of those forms which constitute our prevalent modern vegetation.

It is my present object shortly to sketch the more recent facts of Devonian and Upper Silurian Botany, and to refer to a few of the general truths which they teach. The rocks called Devonian in Europe being on the horizon of the Erie division of the American geologists, which are much more fully developed than their representatives on the Eastern Continent, I shall use the term *Erian* as equivalent to Devonian, understanding by both that long and important geological age intervening between the close of the Upper Silurian and the beginning of the Carboniferous.

Just as in Europe the rocks of this period present a two-fold aspect, being in some places of the character of a deposit of "Old Red Sandstone," and in others indicating deeper water, or more properly marine conditions, so in America, on a greater scale, they have two characters of development. In the great and typical *Erian* area, extending for seven hundred miles to the westward of the Apalachian chain of mountains, these rocks, sometimes attaining to a thickness of fifteen thousand feet, include extensive marine deposits; and except in their north-eastern border are not rich in fossil plants. In the smaller north-eastern area, on the other hand, lying to the eastward of the Apalachian range, they consist wholly of sandstones and shales,

and are rich in plant remains while poor in marine fossils. Hence it is the Devonian of Gaspé, of New Brunswick, and of Maine, with that of eastern New York, which have chiefly afforded the plants to be described below; and it is exclusively in these areas that we find underclays with roots, or true fossil soils. Most of the localities of fossil plants in the districts above mentioned have been visited, and their plants studied *in situ* by the writer. The Gaspé sandstones were first studied and carefully measured and mapped by Sir W. E. Logan. The Devonian beds of St. John's, New Brunswick, have been thoroughly examined and illustrated by Professor Hartt and Mr. Matthews, and those of Perry by Professor Jackson, Professor Rogers and Mr. Hitchcock. Professor Hall, of the Survey of New York, has kindly communicated to me the plants found in that State, and Professor Newberry has contributed some facts and specimens illustrative of those of Ohio.

In the Sandstone cliffs of Gaspé Bay, Sir W. E. Logan recognized in 1843 the presence of great numbers of apparent roots in some of the shales and fine sandstones. These roots had evidently penetrated the beds in a living state, so that the root-beds were true fossil soils, which, after supporting vegetation, became submerged and covered with new beds of sediment. This must have occurred again and again in the process of the formation of the four thousand feet of Gaspé sandstone. The true nature of the plants of these fossil soils I had subsequently good opportunities of investigating, and the most important results, in the discovery of the plants of my genus *Psilophyton*, are embodied in the restoration of *P. princeps*. This remarkable plant, the oldest land plant known in America, since it extends through the Upper Silurian as well as the Devonian, presents a creeping horizontal rhizome or root-stock, from the upper side of which were given off slender branching stems, sometimes bearing rudimentary leaves, and crowned when mature, with groups of gracefully nodding oval spore-

cases. The root-stocks must in many cases have matted the soils in which they grew into a dense mass of vegetable matter, and in some places they accumulated to a sufficient extent to form layers of coaly matter, one of which on the south side of Gaspé Bay is as much as three inches in thickness, and is the oldest coal known in America. More usually the root-beds consist of hardened clay or fine sandstone filled with complicated net-work or with parallel bands of rhizomes more or less flattened and in various states of preservation. In all probability these beds were originally swampy soils. From the surface of such a root-bed there arose into the air countless numbers of slender but somewhat woody stems, forming a dense mass of vegetation three or four feet in height. The stems, when young or barren, were more or less sparsely clothed with thick, short, pointed leaves, which, from the manner in which they penetrate the stone, must have been very rigid. At their extremities the stems were divided into slender branches, and these when young were curled in a crosier-like or circinate manner. When mature they bore at the ends of small branchlets pairs of oval sacs or spore-cases. The rhizomes when well preserved show minute markings, apparently indicating hairs or scales, and also round areoles with central spots, like those of Stigmaria, but not regularly arranged. These curious plants are unlike anything in the actual world. I have compared their fructification with that of the Pilulariæ or Pillworts, a comparison which has also occurred to Dr. Hooker. On the other hand, this fructification is borne in a totally different manner from that of Pilularia, and in this respect rather resembles some ferns; and the young stems by themselves would be referred without hesitation to Lycopodiaceæ. In short, Psilophyton is a generalized plant, presenting characters not combined in the modern world, and, perhaps illustrating what seems to be a general law of creation, that in the earlier periods low forms assumed characteristics subsequently confined to higher grades of being.

A second species of Psilophyton (*P. robustius*), also abundant at Gaspé, shows stouter stems than the former, more abundantly branching and with smaller leaves, often quite rudimentary. Its spore-cases are also of different form and borne in dense clusters on the sides of the stem. Masses of very slender branching filaments appear to indicate a third species (*P. elegans*) which is also found in the Devonian of St. John, New Brunswick. These species of Psilophyton occur both in the lower and middle Devonian, and, as will be mentioned in the sequel, they extend also into the Upper Silurian.

Decorticated and flattened stems of Psilophyton cannot be readily recognized, and except when their internal structure has been preserved, might be mistaken for algæ, a mistake which I believe has in some instances been made. Specimens of the barren stems (*var. ornatum*) might readily be referred to the genus *Lycopodites*.

Another genus of generalized type is that named by Haughton *Cyclostigma*. As found at Gaspé it presents slender stems with rounded scars, placed either spirally or in transverse rows, and giving origin to long rigid leaves. It had a slender axis of scalariform vessels, and fructification of the form of elongated spikes or strobiles is found with it. In many respects these plants resemble Psilophyton, and their affinities were distinctly Lycopodiaceous. Specimens from Ireland, in the Museum of the Geological Society, kindly shown to me by Mr. Etheridge, appear to show that in that country these plants attained the dimensions of trees, and had roots of the nature of Stigmaria. Mr. Carruthers has even suggested that they may be allied to *Syringodendron*, a group of Carboniferous trees connected with the *Sigillariæ*.

The genus *Lycopodites* is represented by a trailing species, bearing numerous oval strobiles (*L. Richardsoni*), a species quite close to many modern club-mosses (*L. Matthewi*), and a remarkable pinnate form (*L. Vanuxemii*);

which, though provisionally placed here, has been variously conjectured to resemble Ferns, Cycads, Algæ and Graptolites. But the most remarkable Lycopodiaceous plants are the gigantic arboreal *Lepidodendra*, plants which, while they begin in the Middle Devonian, become eminently expanded in numbers and magnitude in the Carboniferous. The common species in Eastern America (*L. Gaspianum*) was of slender and delicate form, very elegant, but probably not of large size. In the same family I would place my new genus *Leptophleum*.

The *Calamites*, afterwards so largely developed in the Carboniferous, and to be replaced by true Equiseta in the Trias, make their first appearance in a large species (*C. inornatum*) in the Lower Devonian, and represented in the middle and upper parts of the system by two other species, which extend upward into the Carboniferous. They are also represented in the Devonian of Germany and of Devonshire. The peculiar type indicated by the internal casts known as *Calamodendron* is likewise found in the Devonian.

More beautiful plants were the *Asterophyllites*, with more slender and widely branching stems, and broader leaves borne in whorls upon their branches. These plants have been confounded with leaves of Calamites, from which, however, they differ in form and nervation, and in the want of the oblique interrupted lines common to the true leaves of Calamites and to the branchlets of Equisetum. The Asterophyllites, and with them a species of *Sphenophyllum*, appear in the Middle Devonian.

No plants of the modern world are more beautiful in point of foliage than the Ferns, and of these a great number of species occur in the Middle and Upper Devonian. I must refer for details to my more full memoirs on the subject, and in the present paper shall content myself with a few general statements. Some of the generic forms of the Devonian, and perhaps a few of the species, extend into the Carboni-

ferous; others are peculiar to the Devonian; and among these forms allied to the modern Hymenophyllum and Trichomanes appear to prevail. One remarkable type, *Cyclopteris* (*Archæopteris*) *Hibernicus*, with its American allies, *C. Jacksoni*, etc., extends in the Upper Devonian over both continents, yet is wanting in the Carboniferous. Tree ferns also existed in the Devonian. Two species have been found by Dr. Newberry in Ohio, and remarkable erect trunks have been obtained by Professor Hall from Gilboa, in the State of New York. The latter are surrounded by aerial roots, and thus belong to the genus *Psaronius;* a genus which, however, must be artificial, since in modern tree ferns aerial roots often clothe the lower part of the stems while absent from the upper part. The only indication as yet of a tree fern in the Old World is the *Caulopteris Peachii*, of Salter, from the Old Red of Scotland. It is further remarkable that the ferns of the genus Archæopteris are much more large and luxuriant in Ireland than in America, and that in both regions they characterize the upper member of the system.

Of the plants of the Palæozoic world, none are more mysterious than those known to us by the name *Sigillaria*, and distinguished by the arrangement of their leaves in vertical series, on stems and branches often ribbed longitudinally, and by the possession of those remarkable roots furnished with rootlets regularly articulated and spirally arranged, the Stigmariæ. It seems evident that this group of plants included numerous species, differing from each other both in form and structure. Still, as a whole, they present very characteristic forms dissimilar from those of their contemporaries, and still more unlike anything now living. I believe that many of them were Gymnosperms, or at the least, Acrogens with stems as complicated as those of Gymnosperms. In the Carboniferous period these plants have a close connection with the occurrence of coal. Nearly every bed of this mineral has under it a "Stigmaria under-

clay," which is a fossil soil on which a forest of Sigillariæ has grown, and the remains of these trees are very abundant in the coal and the accompanying beds. Hence the Sigillariæ of the coal-period are regarded as the plants most important in the accumulation of coal. In the Devonian, as far as we yet know, they did not attain to this utility, and in the lower part of the system at least, the rhizomata of Psilophyton seem to have occupied the place afterwards held by the Stigmariæ. In connection with this it is to be remarked that the Sigillariæ of the Erian period seem to have been few, and of small dimensions in comparison with those of the coal.

Rising still higher in the vegetable kingdom, and arriving at unquestionable Gymnosperms, we find in the Devonian of Eastern America, and also, I believe, in that of Scotland and Germany, trunks which may be referred to Coniferæ. In the Middle and Upper Devonian these present the structure of modern Araucarian pines, or that modification of it belonging to the Carboniferous trees of the genus *Dadoxylon*. In the Lower Devonian we have what seems to be a simplification of the Coniferous structure, in the cylindrical wood-cells, marked only with spiral threads, found in the genus *Prototaxites*. These trees are very abundant as drift trunks in the Lower Devonian, down almost to its bottom beds, and sometimes attain to a diameter of three feet. Though of a structure so lax that it is comparable only with the youngest stems of ordinary Coniferæ, these trees must have been durable, and they are furnished both with medullary rays and rings of annual growth. Unfortunately we know nothing of their foliage or fruit.

But for one little fragment of wood we should have had no indication of the existence in the Erian of any trees of higher organization than the Conifers. This fragment, found by Professor Hall at Eighteen-mile Creek, Lake Erie, has the dotted vessels characteristic of ordinary Exogens, and unquestionably indicates a plant of the highest kind of

organization. Until confirmed by other facts this discovery may be received with doubt, but I believe it can be relied on.

Our knowledge of the flora of the Upper Silurian is at present nearly in the same state with that of the Middle and Lower Devonian ten years ago. I know in the Upper Silurian of Canada but two species of *Psilophyton*, both apparently identical with Devonian forms. In England, besides the spore-cases known by the generic name *Pachytheca*, there exists in the collections of the Geological Survey fragments of wood and bark which I believe indicate two additional species. In Germany three or four species are known in rocks of this age. All of these plants appear to be Acrogens allied to Lycopodiaceæ. That these few species constitute the whole flora of the Upper Silurian we can scarcely believe. They occur in marine formations, and were probably drifted far from the somewhat limited land-surfaces which existed in the explored parts of the Upper Silurian areas. When we obtain access to deposits of this age formed in shallows or estuaries, we may hope to find a flora of greater richness; and, judging from present indications, not dissimilar from that of the Lower Devonian.

With the exception of some remains which I believe to be of very doubtful character, the Lower Silurian has as yet afforded no remains of land plants, and in North America, at least, this is very significant, inasmuch as we have, in the Potsdam sandstone, extensive sandy flats of this period, in which we might expect to find drifted trunks of trees, if such had existed. But the search is not hopeless, and we may yet find some estuary deposit on the margin of the ancient Laurentian continent, in whose beds the plants of that old land may occur.

Lastly, for reasons stated in a paper lately published in the Proceedings of the Geological Society, I believe that the extensive deposits of graphite, which exist in the Laurentian of Canada, are of vegetable origin, and possibly in part

produced by land plants, as yet altogether unknown to us. If the Palæozoic was the age of Acrogens, the Eozoic may have been that of Anophytes and Thallophytes. Its plants may have consisted of gigantic mosses and lichens, presenting us with a phase of vegetable existence bearing the same relation to that of the Palæozoic which the latter bears to that of more modern periods. But there is another and a more startling possibility, that the Laurentian may have been the period when vegetable life culminated on our planet, and existed in its highest and grandest forms, before it was brought into subordination to the higher life of the animal. The solution of these questions belongs to the future of geology, and opens up avenues not merely for speculation, but also for practical work.

The above must be regarded as merely a sketch of the present aspect of the subject to which it relates. Details must be sought elsewhere.—*Nature.*

INDIAN STONE IMPLEMENTS.*

BY J. J. H. GREGORY.

THE stone selected for arrowheads and tomahawk points, was, as a rule, very hard in its nature, compact in structure, and fine grained, presenting a conchoidal fracture when broken. In the valley of the Connecticut these conditions were satisfied by a variety of hornstone, along the sea coast in the porphyry. In each of these localities I have found some arrowheads made of jasper, some of white granular quartz, and occasionally one from slate, but the greater proportion of these are collectively small, though it is evident

* Observations on the Stone used by the Indians within the limits of Massachusetts, in the manufacture of their implements, with some remarks on the process of manufacture, read at the Troy meeting of the American Association for the Advancement of Science.

that beauty in the material had attractions. One great source of supply for the jasper and quartz implements, was in part or wholly scattered boulders, while the porphyry came from the ledges on Marblehead Neck, and the small boulders washed up along the coast. That boulders were frequently used is proved from many half formed implements which show some of the rounded surface yet remaining. That the porphyry ledges on Marblehead Neck were an extensive source of supply, is proved by the cart loads of chippings of stone around and in the vicinity of them. That these pieces and fragments were artificially broken is proved by the many conchoidal surfaces, the fresh appearance of the surfaces, and the rough design which some of these present.

That the practice of the aborigines was to cut out but rough designs at the quarry, and work out these designs at their camping grounds, is proved by the large size of the fragments chipped off near these ledges, and the scarcity of even rough designs; while in the town of Marblehead, about a mile from the porphyry ledges on the Neck, the chippings are smaller, and the designs are nearer to completion. In the township of Marblehead I have found a multitude of implements, over a thousand in number, that were broken in every stage of the process of manufacture, while I have rarely found in the Connecticut valley fragments of unfinished implements; such as I have found are usually those of finished implements. The chippings of stone on Marblehead Neck, as I have shown, average quite large; those in the township considerably smaller, and the chippings found in the Connecticut valley are yet smaller.

The hornstones so commonly used for arrowheads and other implements there I have never found in Marblehead, and I have never found among implements of the Connecticut valley any manufactured from the porphyry of Marblehead. In one of the Reports of the Smithsonian Institution is an account of the finding of a mass of half finished imple-

ments buried in the ground; such deposits simply prove that the aborigines having cut out rough outlines of implements, at times carried these to their camping ground, and there buried them, to be finished at leisure. I exhibit specimens of a lot that I dug up in Marblehead, on the Freeto farm, about a foot below the surface; such deposits are called "Indian pockets." There were over forty pieces in the lot.

Here is one of a lot of nearly a peck, found in Hadley, Mass. The quantity in every case appeared in each instance to be about equal, apparently limited by the weight one person might conveniently carry. From a study of the breakage we learn that in making their arrowheads and tomahawk points they chipped the stone from the edge towards the centre, which, while it gave a sharp edge, left a central ridge that gave strength to the weapon. In finishing arrowheads there was a great deal of slow, careful work, which finally consisted in breaking off particles almost as fine as dust, by gentle pressure against stone. I had one arrowhead brought to me by a friend from California, made from the bottom of a glass bottle; it was very sharp and exquisitely finished. It was mostly made in his presence by an Indian squaw and nearly three days were spent in its manufacture. It can be safely stated that with the same tools no white man can make an Indian arrowhead; I am informed that even Flint Jack, skilled as he was in the business, after many years of practice, failed in his "Celts," as stone arrowheads are called in England.

From the very few arrowheads made from red jasper, found in Marblehead, I doubt whether the fine ledge of jasper located in Saugus, about five miles distant, was known to the aborigines, as the rich color of the stone, with its fine conchoidal fracture, would have been likely to have made it very popular. The material for the few arrowheads found, made of red jasper, I presume was procured from rocks of the drift deposit. The rocks used by the Indians on the coast in the manufacture of their larger implements, such as

axes, gouges, skin dressers and grain pestles, were greenstone and syenite, and in the Connecticut valley a large portion were made from trap rock. Evidently one reason why the greenstone and syenite were preferred to the porphyry was that these would take the fine finished design far more readily than porphyry. We find the difference between these rocks, illustrated by the ocean worn stones on the beach; while those from trap and greenstone, are as smooth as polished metal. Porphyry stones under the same circumstances, while they have a fine general polish, will yet oftentimes have many minute fractures below the level of the polished surface. These large implements appear to have had their forms first roughly hewn out, then to have been worked into shape by picking with sharp pointed stones after which they were sometimes polished. The axes as a rule were not polished, while the implements used in the dressing of skins were, almost uniformly. Sometimes when the natural form of the material favored, such as fragments of trap rock for pestles and for hoes, but little additional work was put upon it, and the implement was but a rough affair.

Of the large implements, as would be presumed from their character, it is rare to find any that were broken in the process of manufacture, while such as have been marred or broken, after having been manufactured, are very common. It is stated by those who have made a comparison between the large implements of this country and of Europe, that those manufactured by the aborigines of this country are hewn, picked and sometimes polished; those of Europe are simply hewn. This marked difference, if it is a fact, is not so singular as appears at first sight; the material, to a large extent, of the European implements, is flint, which, while it cannot be surpassed as a material for hewing, yet for picking and polishing, would prove very refractory, and it is probable that the same motives that led our own aborigines to avoid the porphyry, led those of Europe to be content

with simply hewing, having to deal with a still more stubborn material in their flint. The skin dressers, gouges and some other implements were made as sharp at the working edges as such stones were capable of, and this was done by rubbing them on fine grained stones. On the sea coast pieces of the finest grained greenstone were mostly used, some of which, when found, were as much worn as any modern carpenter's hone.

I have never seen among the relics on the sea coast any resembling the scalping knives of the West, or of Europe, or any whose peculiar shape suggested that it might have been used as a scalping knife. I infer from this that on the sea coast the large chippings of stone, having a sharp edge, were used as scalping knives. Among some fifteen hundred specimens of Indian implements, collected on the sea coast, I have never seen more than one, that, from its shape and size could possibly have been used as the conventional tomahawk, an axe shaped weapon to be thrown from the hand. The illustrations in some of our modern school books are more correct when the tomahawk is shown to have been a wooden club terminating in a hard woody knob, in which had been inserted a large stone point.

The form of the metallic axe was doubtless copied from the same implement used by the inhabitants of the stone age. From time to time the metallic axe has varied in form, and all the several forms of stone axes I have in my possession have been represented in some of the forms of the metallic axe, and as that of the standard axe of to-day is precisely that of one of these forms, I cannot doubt but that the stone implement supplied the model.

REVIEWS.

THE POLYPS AND CORALS OF THE NORTH PACIFIC EXPLORING EXPEDITION.*—Professor Verrill here describes, with numerous figures by Dr. Stimpson, all the Polyps and Corals collected, with notes on their colors and appearance in life, by Dr. Stimpson, which are new to science. It is an important addition not only to our knowledge of the various forms of Polyps and Corals especially, but also to their geographical and bathymetrical distribution. An excellent summary of the class of "Cnidaria," or Polyps, precedes the account of new species. The class is divided into three orders (the Madreporaria, Actinaria, and Alcyonaria,) with short definitions of the suborders into which these three groups are divided. We reproduce two of the plates from the "Proceedings" of the Essex Institute, which represent some of the more interesting forms illustrating the different groups of Polyps of the suborder Pennatulacea. Fig. 1 represents a polyp of a sea pen, *Pteromorpha expansa* Verrill; Fig. 2, the animal of *Virgularia pusilla* V.; Fig. 3, of *Veretillum Stimpsonii* V.; Fig. 4 shows the whole colony of *Kophobelemnon clavatum* V., with the polyps, or single animals, protruding from the surface. These sea pens (so called from the resemblance, in the genus Pennatula, of the whole colony to a pen) move freely about in the mud or sand at the bottom of the sea. They belong to the most highly organized polyps, the order of Alcyonaria, in which the number of tentacles of each polyp is restricted to eight. All the above named sea pens are from Hong Kong.

Of the sea fans, or Gorgonacea, the second suborder of Alcyonaria, Verrill figures (5) the coral stock, and animal (5*a*) of *Muricea Sinensis* V.; 6, the coral stock, and 6*a* the animal of *Muricea divaricata* V.; and Fig. 7, the animal of an allied coral, *Acanthogorgia coccinea* V., of which 7*a* represents a top view, with the eight tentacles outspread. All three are from Hong Kong.

Of the soft Alcyoniums, called in England Dead Men's Fingers, which do not secret a coral, our author figures the animal of *Nepthya thyrsoidea* V. (Fig. 8, 8*a*, a polyp), from the Cape of Good Hope; *Anthella lineata* Stimps., Fig. 9; 9*a*, a polyp; 9*b*, one of the tentacles much enlarged, from Hong Kong; and *Telesto ramiculosa* V. (Fig. 10, polyp-colony; 10*a*, a polyp), from the same locality. An interesting sea Anemone, *Sagartia? paguri* V., was dredged in twenty to thirty fathoms, and said by Dr. Stimpson to be always parasitic on a hermit crab, *Diogenes Edwardsii* of Stimpson. Another form, *Cancrisocia expansa* Stimpson, Fig. 94,

"Is the only genus of Actinidæ, except Adamsia (*A. palliata*), in which a solid secretion is formed by the basal disk. In Cancrisocia it has a concentrically striate structure, the striæ

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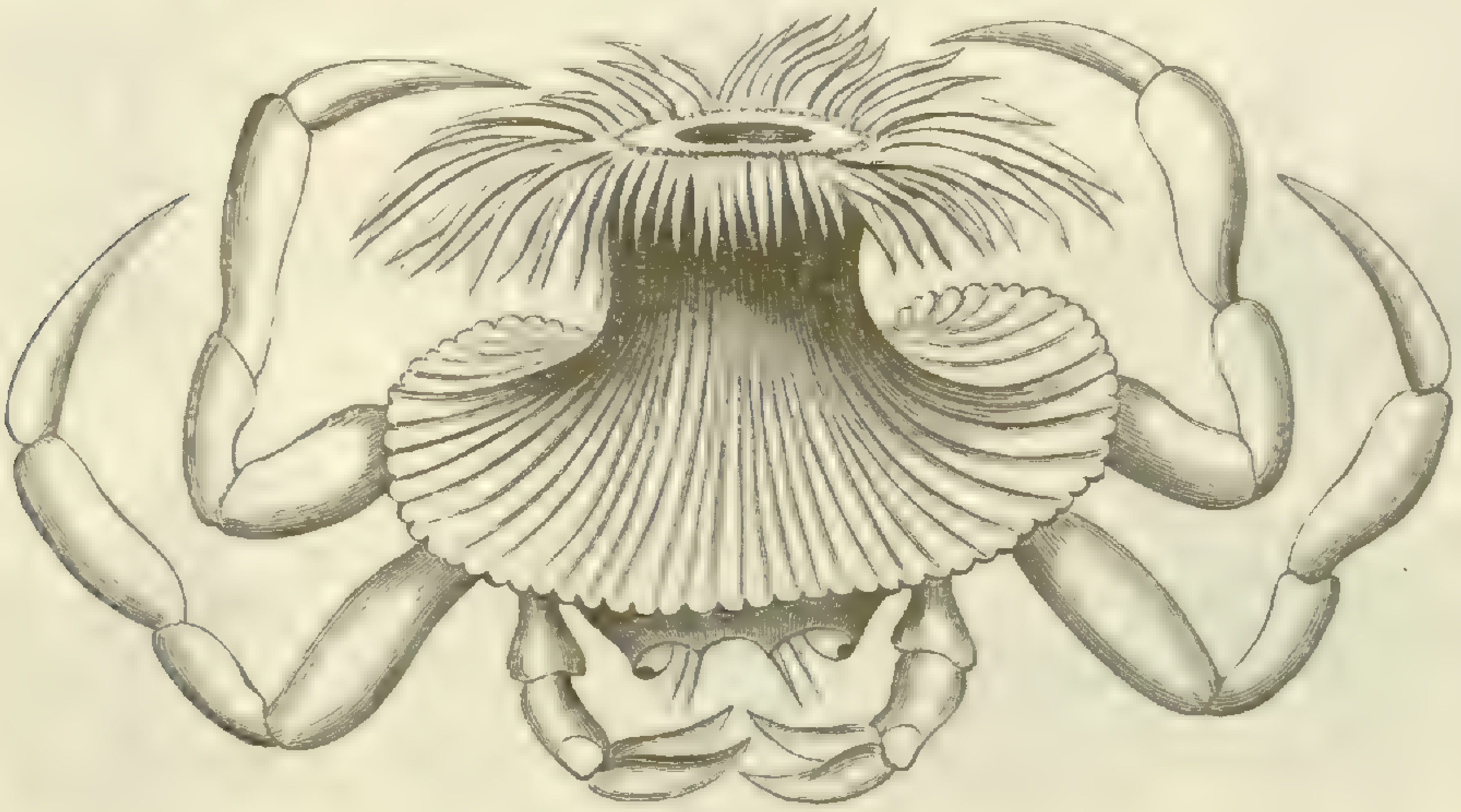
* Synopsis of the Polyps and Corals of the North Pacific Exploring Expedition, under Commodore C. Ringgold and Capt. John Rodgers, U. S. N., from 1853 to 1856. Collected by Dr. Wm. Stimpson, Naturalist to the Expedition. By A. E. Verrill. [From the Proceedings of the Essex Institute. Vols. 4-6. Salem, Mass. 1866-1869. 8vo. pp. With 6 plates.]

being evidently lines of growth. The mode of formation seems to be this: The crab when very young, selects a very small fragment of shell or pebbles, which it holds upon its back by its posterior claws, as other species of Crabs (*Hypoconcha*) do, a valve of Pecten, or some other bivalve shell. Upon this small shelly, or stony fragment, the very young Cancrisocia finds a congenial abode; but soon growing too large for its station it enlarges its support by depositing a layer of horn-like material, secreted by the base, around its circumference, and this process is continually repeated, in proportion to its own growth, and that of the crab that carries it. In this way there is soon formed a broad thin pellicle, having its concentric elements arranged around a nucleus of stone or shell, which is usually excentric, the increase having been more rapid in front than behind. This basal secretion is held upon the back of Dorippe by its recurved posterior legs, in the same manner as the original bit of shell."

The division of Corals he raises to the rank of an order, under the term *Madreporaria*, thus making it parallel with the Alcyonaria. Among these corals numerous new forms are described and figured.

Fig. 94.



Cancrisocia expansa.

A number of species from various parts of the world are added in a supplement. The geographical list shows that most of the species are from the Seas of East India and China, the South Seas, Cape of Good Hope, and the West Coast of America.

Revue des Cours Scientifiques.* — This journal, now in its eighth year, is valuable as giving us reports of the lectures of prominent scientists in Europe, and occasionally our own country. Late numbers contain lectures by Marey on the flight of birds and insects; by Agassiz and Carpenter on deep sea dredgings; and lectures by Huxley, Claude Bernard, and the leading physicists and physiologists in France. It also contains a full report of the discussions in the recent sessions of the French Academy relative to the qualifications of Mr. Darwin to be elected a member of that body. Considering the bigotry and unscientific spirit, to say nothing of the surprisingly low grade of scientific acquirements displayed by some of the members, we should judge that if an opportunity should offer Mr. Darwin would decline the honor (*sic*) of membership.

* Edited by MM. Eug. and Yung Em. Alglave. 15 francs a year. 4to, pp. 15. Weekly. Each volume about 900 pages. Germer Balliere, 17 Rue de l'Ecole-de-Medicine, Paris.

NORTH PACIFIC POLYPS AND CORALS.

Fig. 9b.

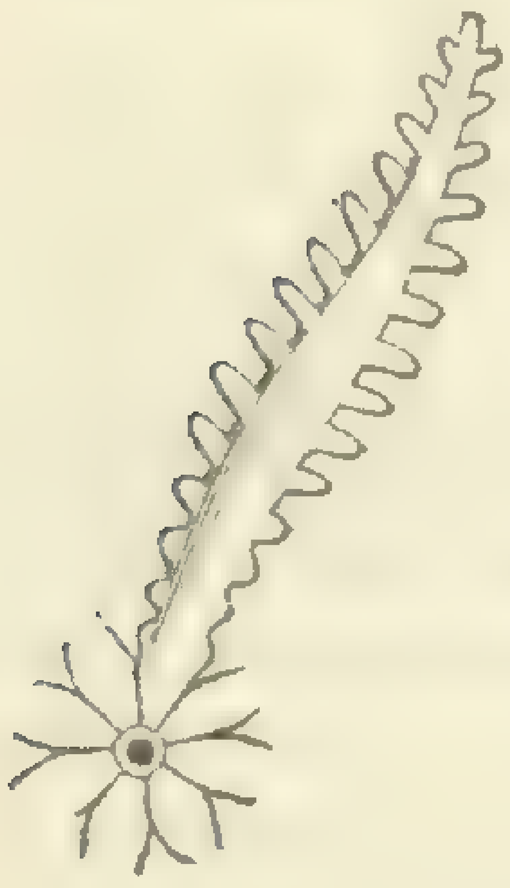


Fig. 8.

Fig. 7.

Fig. 7a.

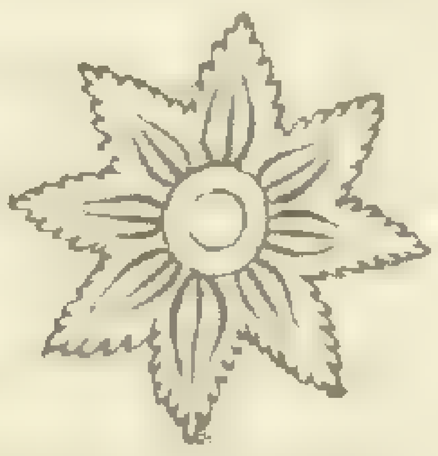


Fig. 9a.

Fig. 8a.

Fig. 10a.

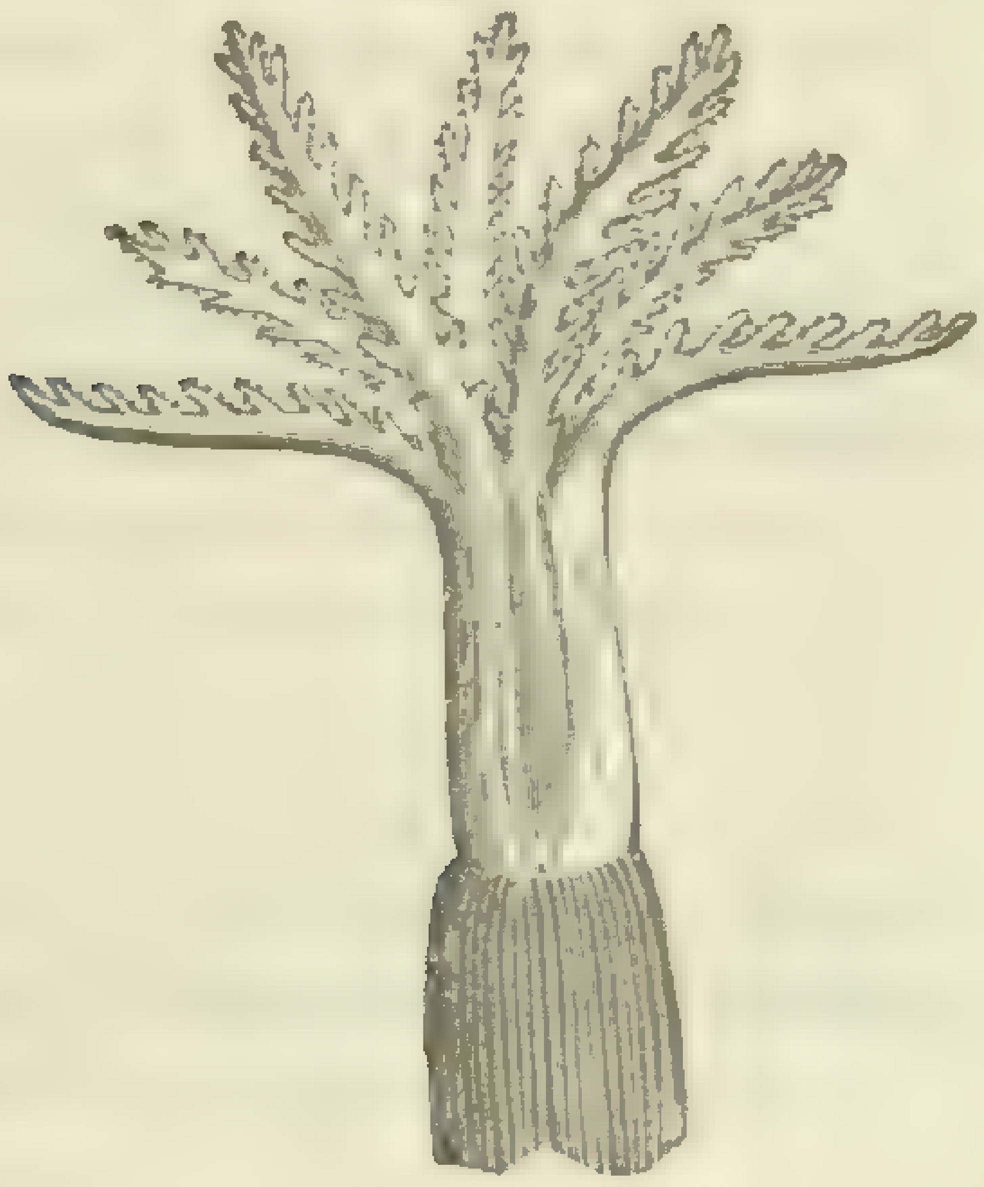


Fig. 10.

Fig. 9.

NORTH PACIFIC POLYPS AND CORALS.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Nineteenth Meeting of the American Association for the Advancement of Science, held at Troy, N. Y., August 17th–24th, 1870. The nineteenth meeting of the Association opened with about one hundred and fifty members. During the meeting about fifty more members entered their names, and one hundred and seventy-one new members were elected. The total number of papers entered amounted to 144, of which 30 were read by title only and 7 were excluded.

The Local Committee had secured convenient rooms for the general sessions, and those of the several sections, at the Court House, the Troy Female Seminary and the First Presbyterian Church. The local secretaries, Messrs. B. H. Hall and H. B. Nason, who, as usual, had the greater part of the Local Committee work on their hands, did all in their power to make the meeting a success, and to furnish accommodations and aid to the members in attendance.

A large and brilliant reception was given to the Association by His Honor Mayor Gilbert, on Thursday evening, and an equally brilliant one by Hon. John M. Francis at his residence, on Monday evening. Monday was occupied by an excursion to Saratoga and dinner at Congress Hall, at the invitation of the citizens of Troy. On Friday morning the Association steamed down the river to Albany, where they were the guests of the Albany Institute and were most hospitably entertained, and visited the *Dudley Observatory*, *State Cabinet*, and the large *private collection* of Professor Hall. Gathering at the *State Library* at half past four o'clock a most delightful evening was passed at a levee given by the Albany Institute, after which a fine sail up the river brought all back to Troy before midnight. "Section Q" was well carried out on Tuesday night.

During the evenings of the session many members availed themselves of the opportunities afforded for visiting the *Bessemer Steel Works*, the *Burden Iron Works*, and the *Rensselaer Iron Works*; the proprietors and superintendents of all the works being most obliging and courteous to the throngs of visitors who invaded their firey quarters.

The address of the Retiring President, J. W. Foster, was delivered on Thursday evening, at the First Presbyterian Church. This address is of such general interest that we print it in full in this number.

The following were the officers of the Troy meeting: — T. Sterry Hunt,* of Montreal, *President*; Joseph Lovering, of Cambridge, *Permanent Secretary*; F. W. Putnam,† of Salem, *General Secretary*; A. L. El-

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* In the absence of President Chauvenet, detained by illness, Vice-President Hunt became the presiding officer of the meeting.

† Professor Hartt being absent on his expedition in Brazil, Mr. Putnam was elected as General Secretary.

WYN, of Philadelphia, *Treasurer*. *Standing Committee*—T. STERRY HUNT, JOSEPH LOVERING, F. W. PUTNAM, ASA GRAY, F. A. P. BARNARD, J. W. FOSTER, O. N. ROOD, JOHN TORREY, E. D. COPE, E. N. HORSFORD, J. E. HILGARD, A. WINCHELL, H. B. NASON. *Section A.—Mathematics Physics, and Chemistry*—F. A. P. BARNARD, of New York, *Permanent Chairman;* G. W. HOUGH, of Albany, *Secretary;* G. W. MAYNARD, of Troy, ELIAS LOOMIS, of New Haven, S. D. TILLMAN, of New York, *Sectional Committee. Subsection C of Section A.—Microscopy*—S. S. HALDEMAN, of Philadelphia, *Permanent Chairman;* R. H. WARD, of Troy, *Secretary. Section B.—Geology and Natural History*—ASA GRAY, of Cambridge, *Permanent Chairman*, and afterwards A. H. WORTHEN, of Springfield, Ill., and JAMES HALL, of Albany; HENRY HARTSHORNE, of Philadelphia, *Secretary*, and afterwards THEODORE GILL, of Washington; JAMES HALL, of Albany, J. G. MORRIS, of Baltimore, ALPHEUS HYATT, of Salem, *Sectional Committee. Subsection E of Section B.*—for one day, Tuesday, Section B. was subdivided, and THOMAS HILL, of Waltham, was elected *Chairman*, and W. H. DALL, of Washington, *Secretary*.

At the last session of the meeting it was voted to accept the invitation of the CALIFORNIA ACADEMY OF SCIENCE to hold a future meeting of the Association at San Francisco, and a committee was appointed to make arrangements for holding the meeting of 1872 in that city.

It was also voted to accept the invitation from Indianapolis, presented by the State Geologist of Indiana, E. T. COX, to hold the twentieth meeting at Indianapolis, commencing on the *Third Wednesday of August*, 1871.

The following officers were elected for the next meeting:—*President*, ASA GRAY, of Cambridge; *Vice-President*, GEORGE F. BARKER, of New Haven; *Permanent Secretary*, JOSEPH LOVERING, of Cambridge; *General Secretary*, F. W. PUTNAM, of Salem; *Treasurer*, WM. S. VAUX, of Philadelphia.

We give abstracts of several of the papers read in Section B. in this number of the NATURALIST, as well as the President's Address. In the November number we shall print others received from the authors, and shall also give extended abstracts of the several papers read in the Subsection of Microscopy, including two on the Binocular Microscope: one by President Barnard of Columbia College, and the other by Dr. Ward of Troy. We shall also then give a list of the papers read in Section B. of which we have not received abstracts, but we trust that it will be a short one, and at this time request those authors who have not yet sent us the promised abstracts to do so at once.

Prof. EDWARD S. MORSE read a paper "On the early stages of Discina." Referring to his communication last year on the early stages of Terebratulina, and the evidence then adduced of the proofs of the close relations existing between the Brachiopoda and the Polyzoa; he said that an examination of the early stages of Discina showed the same simple lophophore, sustaining a few cirri, the stomach hanging below, and other features in which a resemblance was seen.

The perivisceral wall is made up of two layers of muscular fibres which cross each other, giving it a reticulated appearance. While the young shell is oval in shape there is marked out a perfectly circular area, indicating that at the outset the embryo possesses a circular plate above and below. The muscles were very large and occupied most of the perivisceral cavity. The setæ fringing the mantle were very long, those from the anterior margin being nearly three times the length of the shell. The mantle margin, the blood lacunæ, and the bands of muscles to move the setæ were all described.

He also spoke "On the organization of Lingula and Discina." Space will only allow us to mention the new points evolved in this communication. He confirmed Carl Semper's view regarding the circulation of Lingula, viz.: that it was carried on by ciliary motion. The perivisceral cavity was in direct communication with the lacunæ of the mantle, and with the cavity of the peduncle. The circulation was voluminous and rapid; no trace of pulsation could be detected. The fluid was not blood proper, but chyle-aqueous, and distinct from this was the proper heart and blood as pointed out by Hancock.

From repeated examination of the oviducts he could state positively regarding the nature of these organs. The internal mouth was plaited and turned towards the sides, the remaining portion of the oviduct was reddish in color, and glandular, and probably performed a renal function as in similar organs among the annelids.

The sexes were separate. The coiled arms had a limited power of motion. The coils could be raised or depressed, and the axis of the coil could be at right angles to the longitudinal axis of the body or parallel to it.

The contents of the stomach were found in all the lobules of the liver, indicating that the food circulated in these hepatic prolongations, as in the annelids. Upon young Lingula a perfectly circular area could be seen near the beak of the shell; this indicated the form of the embryo shell and coincided with that of Discina. The movements of living *Lingula pyramidata*, upon which these observations were made, were described. As they live in the sand upright, their peduncle encased in a sand tube, it was interesting to notice a modification in their habits when confined in a bowl. In a short time after confinement they had built new tubes which adhered to the bottom of the bowl through their whole length. They would extend from these tubes, or withdraw when alarmed. All of the specimens he had brought from North Carolina in May were alive at this date, August 19th. They had been confined in a small bowl, with a little sand, and the water changed every two or three days. This vitality was suggestive, since Lingula had existed from the earliest geological ages to the present time.

In describing Discina he mentioned in detail, the muscular, alimentary, circulatory and reproductive systems. The oviducts were very conspicuous, and had broad trumpet shaped mouths. The so-called arteries of Hancock were traced to a ganglionic enlargement in the divaricator muscles, and were unquestionably nerves as pointed out by Owen.

Professor EDWARD S. MORSE also made a communication "On Brachiopods as a division of the Annulata." A brief abstract of these views was published in the July number of this magazine. A few new facts have been added which have been noticed under the description of Lingula.

Attention was called to the Sipunculoid worm with its anterior termination of intestine, and oviducts; its long retractor muscles, and the bilobed lophophore of its young, as described by Kowalewsky, as further proofs of the annulate character of the Brachiopods.

Dr. THOMAS HILL read a paper on "The Compass Plant." In June, 1869, Dr. Hill was coming from Omaha to Chicago, on a very dark rainy day, so dark that he could not form any estimate of the points of compass from the sunlight. At three different points on the prairies he noticed young plants of *Silphium laciniatum*, and estimated from them, while going at full speed, the course of the railway track. On reaching Chicago he procured by the kindness of the officers of the C. & N. W. road, detailed maps of the track, and found where he had estimated the bearing at 35°, 75°, and 90°, the true bearings were 31°, 78°, and 90°.

In October, 1869, being detained by an accident at Tama, he gathered seed, and this spring raised a few seedlings. Drought and insects destroyed part of them, and he could only give the history of eight plants, with fourteen leaves. Ten of these fourteen leaves showed a strong disposition, when about four inches high, to turn to the meridian; the other four showed a feeble disposition in the same direction. These ten leaves on coming up in June, had an average bearing of 42°, and the mean bearing was nearly as large. But in August, the same ten leaves showed an average bearing of only 4½°, and the mean bearing was but 2½°.

Dr. Hill refers this polarity to the sunlight, the two sides of the leaf being equally sensitive, and struggling for equal shares. He hoped in a more favorable summer to test this, and several other points which had suggested themselves, by experiments.

Professor JAMES ORTON read a paper upon the "Condor and the Humming Birds of the Equatorial Region." He remarked that probably no bird is so unfortunate in the hands of the curious and scientific as the Condor. Fifty years have elapsed since the first specimen reached Europe, yet to-day the exaggerated stories of its size and strength are repeated in many of our text books, and the very latest ornithological work leaves us in doubt as to its relation to the other vultures. No one credits the assertion of the old geographer, Marco Paulo, that the Condor can lift an elephant from the ground high enough to kill it by the fall; nor the story of the traveller, so late as 1830, who declared that a Condor of moderate size, just killed, was lying before him, a single quill feather of which was twenty paces long. Yet the statement continues to be published that the ordinary expanse of a full grown Condor, is from fifteen to twenty feet, whereas it is very doubtful if it ever exceeds or even equals twelve feet. I have a full grown male from the most celebrated locality in the Andes, and the stretch of its wings is nine feet. Humboldt

never found one to measure over nine feet; and the largest specimen which Darwin saw, was eight and one half feet from tip to tip. An old male in the Zoological Gardens of London, measures eleven feet. It is not yet settled that this greatest of unclean birds is generically distinct from the other great vultures. My own observation of the structure and habits of the Condor, incline me to think it should stand alone. Associated with the great Condor is a smaller vulture, having brown or ash-colored plumage instead of black and white, a beak wholly black instead of black at the base and white at the tip, and no caruncle. It inhabits the high altitudes, and is rather common. This was formerly thought to be a distinct species; but lately ornithologists have with one accord pronounced it the young of the Sarcoramphus gryphus — a conclusion which the speaker did not seem wholly to endorse.

As to the royal Condor, Professor Orton offered the following observations, either new or corroborative: Its usual habitation is between the altitudes of ten thousand and sixteen thousand feet. The largest seem to make their home around the volcano of Cayambi, which stands exactly on the Equator. In the rainy season they frequently descend to the coast, where they may be seen roosting on trees; on the mountains they rarely perch. but stand on the rocks. They are most commonly seen around vertical cliffs, perhaps because their nests are there, and also because cattle are likely to fall there. Flocks are never seen except around a large carcass. It is often seen singly, soaring at a great height in vast circles. Its flight is slow. It never flaps its wings in the air, but its head is always in motion as if in search of food below. Its mouth is kept open and its tail spread. To rise from the ground it must needs run for some distance; then it flaps its wings three times and soars away. A narrow pen is therefore sufficient to imprison it. In walking the wings trail on the ground and the head takes a crouching position. Though a carrion bird it breathes the purest air, spends much of its time soaring three miles above the sea. Humboldt saw one fly over Chimborazo. I have seen them sailing at one thousand feet above the crater of Pichincha. Its gormandizing power has hardly been overstated. I have known a single Condor, not of the largest size, to make way in one week with a calf, a sheep, and a dog. It prefers carrion, but will sometimes attack live sheep, deer, dogs, etc. The eyes and tongue of a carcass are the favorite parts and first devoured; next the intestines. I never heard an authenticated case of its carrying off children, nor of it attacking adults, except in defence of its eggs. In captivity it will eat everything except pork and fried or boiled meat, When full fed it is exceedingly stupid, and can be caught by the hand; but at other times it is a match for the stoutest man. It passes the greater part of the day sleeping, searching for prey in the morning and evening. It is seldom shot (though it is not invulnerable as once thought), but is generally caught in traps. The only noise it makes, is a hiss like that of a goose — the usual tracheal muscle being absent. It lays two white eggs on an inaccessible ledge. It makes no nest proper, but places a few sticks around the eggs. By no

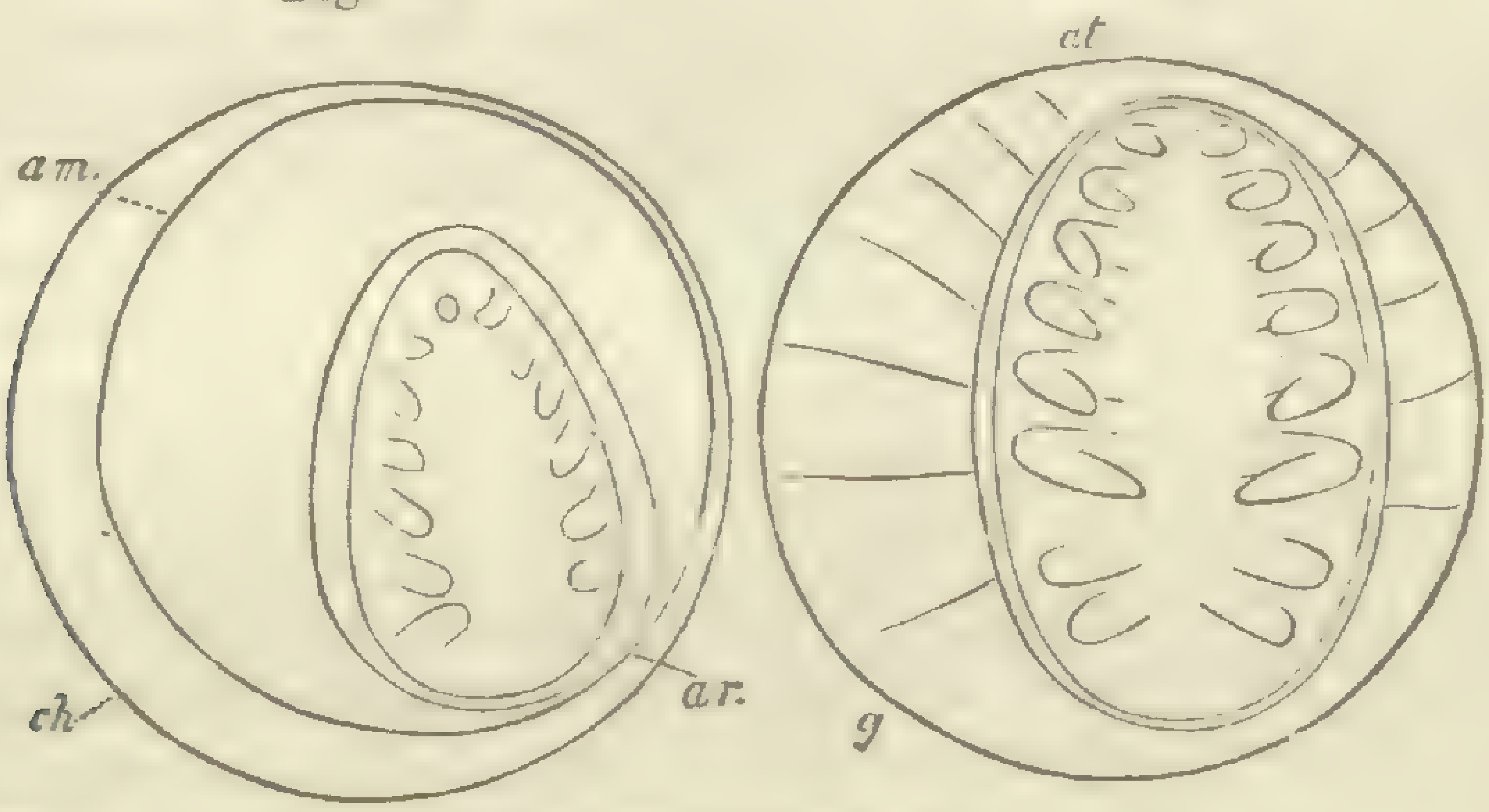
amount of bribery could I tempt an Indian to search for Condor's eggs, and Mr. Smith, who had hunted nearly twelve years in the Quito Valley, was never able to get sight of one. Incubation occupies about seven weeks, ending in April or May (in Patagonia much earlier, or about February). The young are scarcely covered with dirty white brown, and are not able to fly until nearly two years old. D'Orbigny says they take the wing in about a month and a half after being hatched, a manifest error, for they are then as downy as goslings. It is five months moulting, and while at that stage when its wings are useless, it is fed by its companion. As may be inferred the moulting time is not uniform. Though it has neither the smelling powers of the dog (as proved by Darwin), nor the bright eyes of the eagle, somehow it distinguishes a carcass afar off. He described in full the appearance of the Condor, remarking that the female is smaller than the male, an unusual circumstance in this order, the feminine eagles and hawks being larger than their mates.

Professor Orton next spoke of the Humming Bird, of the habits and economy of which our knowledge is very meagre. The relationship between the genera is not clear, and one species is no more typical than another. The only well marked divisions we can discover, are those adopted by Gould and Gray, the Phæthornithinæ and Polytminæ. The former are dull colored and frequent the dense forests. They are more numerous on the Amazon than the other group; and I know of no specimen from the Quito Valley, or from an altitude above ten thousand feet. Their nests are long, covered with lichens, lined with silk and hung over water courses. The latter comprises the vast majority of the Humming Bird, or nearly nine-tenths. They delight in sunshine, and the males generally are remarkable for their brilliant plumage. Their head-quarters seem to be near New Granada; some species are confined to particular volcanoes, or an area of a few miles square. Of the four hundred and thirty known species of Humming Birds, thirty-five are found in and around the valley of Quito, thirty-two on the Pacific slope, and seventeen on the Oriental side of the Andes, making a total of eighty-four, or about one-fifth of the family within the Republic of Ecuador. If the wanton destruction of Humming Birds for mere decorative purposes, continues for the next decade, as it has during the last, several genera may become utterly extinct. This is evident when we consider that many a genus is represented by a single species, which species has a very circumscribed habitat, and multiplies slowly, producing but two eggs in a year. He noticed one fact in regard to the nests of Humming Birds, which he could not explain. Our northern hummer glues lichens all over the outside; so do a number of species in Brazil, Guiana, etc. But in the valley of Quito moss invariably is used, though lichens abound. A similar variation is seen in the nests of the chimney swallow — our species building of twigs glued together with saliva, while its Quito representative builds of mud and moss. The time of incubation at Quito is twelve days, and there is but one brood in a year.

DR. A. S. PACKARD, Jr., presented a paper on "the Embryology of *Limulus Polyphemus*." The eggs on which the following observations were made were kindly sent me from New Jersey, by Rev. Samuel Lockwood, who has given an account of the mode of spawning, and other habits, in the AMERICAN NATURALIST. They were laid on the 16th of May, but it was not until June 3d that I was able to study them. The eggs measure .07 of an inch in diameter, and are green. In the ovary they are of various hues of pink and green just previous to being laid, the smaller ones being, as usual, white. The yolk is dense, homogeneous, and the yolk granules, or cells, are very small, and only in certain specimens, owing to the thickness and opacity of the egg-shell, could they be detected.

Not only in the eggs already laid, but in unfertilized ones taken from the ovary the yolk had shrunken slightly, leaving a clear space be-

Fig. 95. Fig. 96.



Embryo of Limulus.

tween it and the shell. Only one or two eggs were observed in process of segmentation. In one the yolk was subdivided into three masses of unequal size. In another the process of subdivision had become nearly completed.

In the next stage observed, the first indications of the embryo consisted of three minute, flattened, rounded tubercles, the two anterior placed side by side, with the third immediately behind them. The pair of tubercles probably represent the first pair of limbs, and the third, single tubercle the abdomen. Seen in outline the whole embryo is raised above the surface of the yolk, being quite distinct from it, and of a paler hue. In more advanced eggs three pairs of rudimentary limbs were observed, the most anterior pair representing the first pair of limbs (false mandibles of Savigny), being much smaller than the others. The mouth opening is situated just behind them. In a succeeding stage (Fig. 95, *ar*, areola; *am*, blastoderm skin; *ch*, chorion) the embryo forms an oval area, surrounded by a paler colored areola, which is raised into a slight ridge. This areola is destined to be the edge of the body, or line between the ventral and dorsal sides of the animal. There are six pairs of appendages, forming elongated tubercles, increasing in size from the head

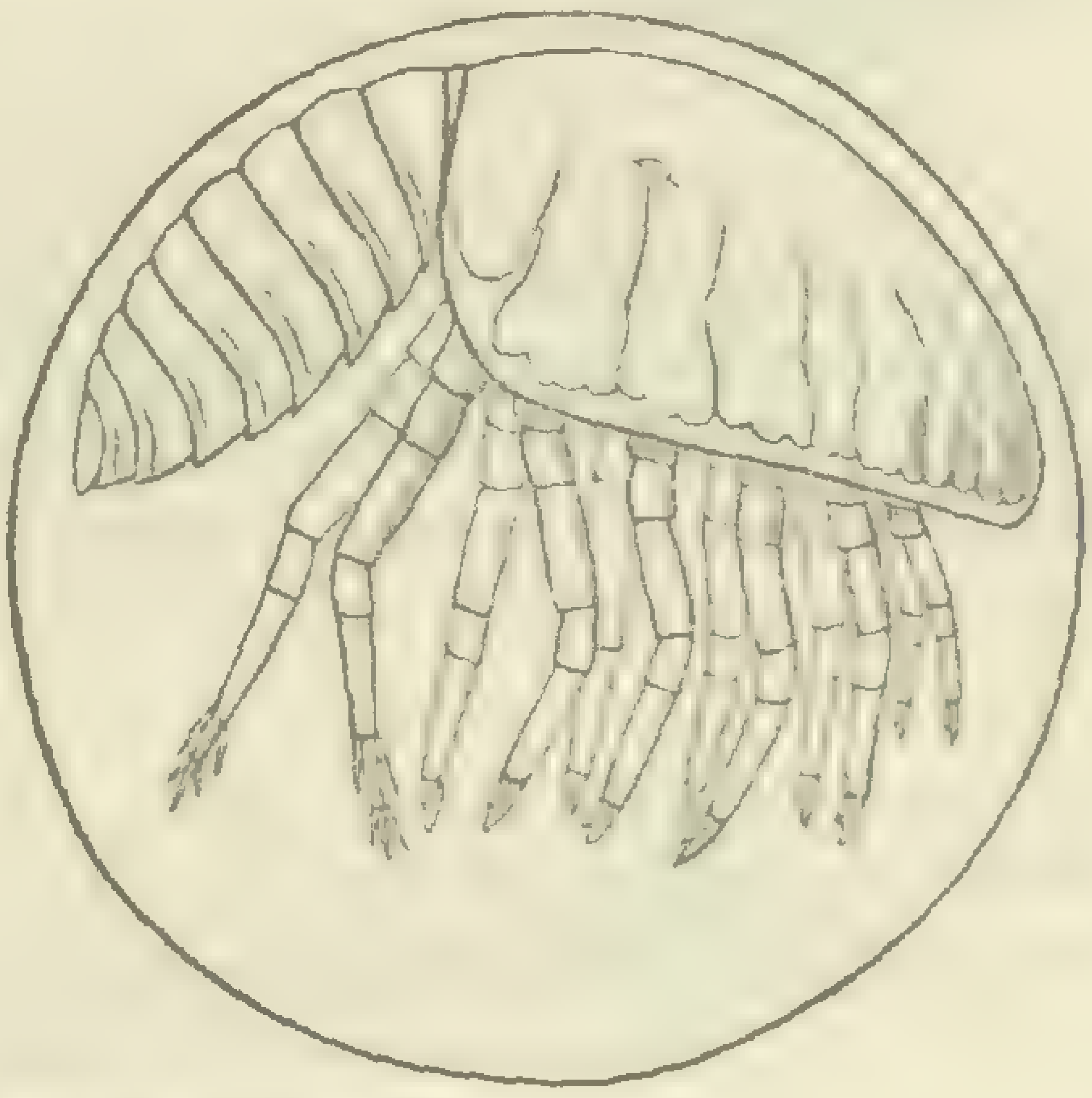
backwards; the mouth is situated between the anterior pair. The whole embryo covers but about a third of that portion of the yolk in sight. At this time the inner egg membrane (blastoderm-skin?) was first detected.

The outer membrane, or chorion, is structureless; when ruptured the torn edges show that it is composed of five or six layers of a structureless membrane, varying in thickness. The inner egg membrane is free from the chorion, though it is in contact with it. Seen in profile it consists of minute cells which project out, so that the surface appears to be finely granulated. But on a vertical view it is composed of irregularly hexagonal cells, sometimes 5-sided, and rarely 4-sided. hardly two cells being alike. The walls of the cells appear double, and are either strongly waved, or have from three to five long slender projections, with the ends sometimes knobbed, directed inwards. These cells are either packed closely together, or separated by quite a wide interspace.

In a subsequent stage (Fig. 96) the oval body of the embryo has increased in size. The segments of the cephalothorax are indicated, and

Fig. 97.

Fig. 98.



Embryo of Limulus just before hatching.

the legs have grown in length, and are doubled on themselves. But the most important change is in the small size of the rudiments of the mandibles, compared with the remaining five pairs of limbs; and the origin of two pairs of gills, forming pale oblique bands between the 6th pair of legs and the end of the abdomen, which forms a narrow semicircular area.

A later stage is signalized by the more highly developed dorsal portion of the embryo, and the increase in size of the abdomen and the appearance of nine distinct abdominal segments. The segments of the cephalothorax are now very clearly defined, as also the division between the cephalothorax and abdomen, the latter being now nearly as broad as the cephalothorax, the sides of which are not spread out as in a later stage. At this stage the egg-shell has burst, and the "amnion" increased in size several times exceeding its original bulk, and has admitted a correspond-

ing amount of sea water, in which the embryo revolves. At a little later period the embryo throws off an embryonal skin, the thin pellicle floating about in the egg.

Still later in the life of the embryo the claws are developed, an additional rudimentary gill appears, and the abdomen grows broader and larger, with the segments more distinct; the heart also appears, being a pale streak along the middle of the back extending from the front edge of the cephalothorax to the base of the abdomen.

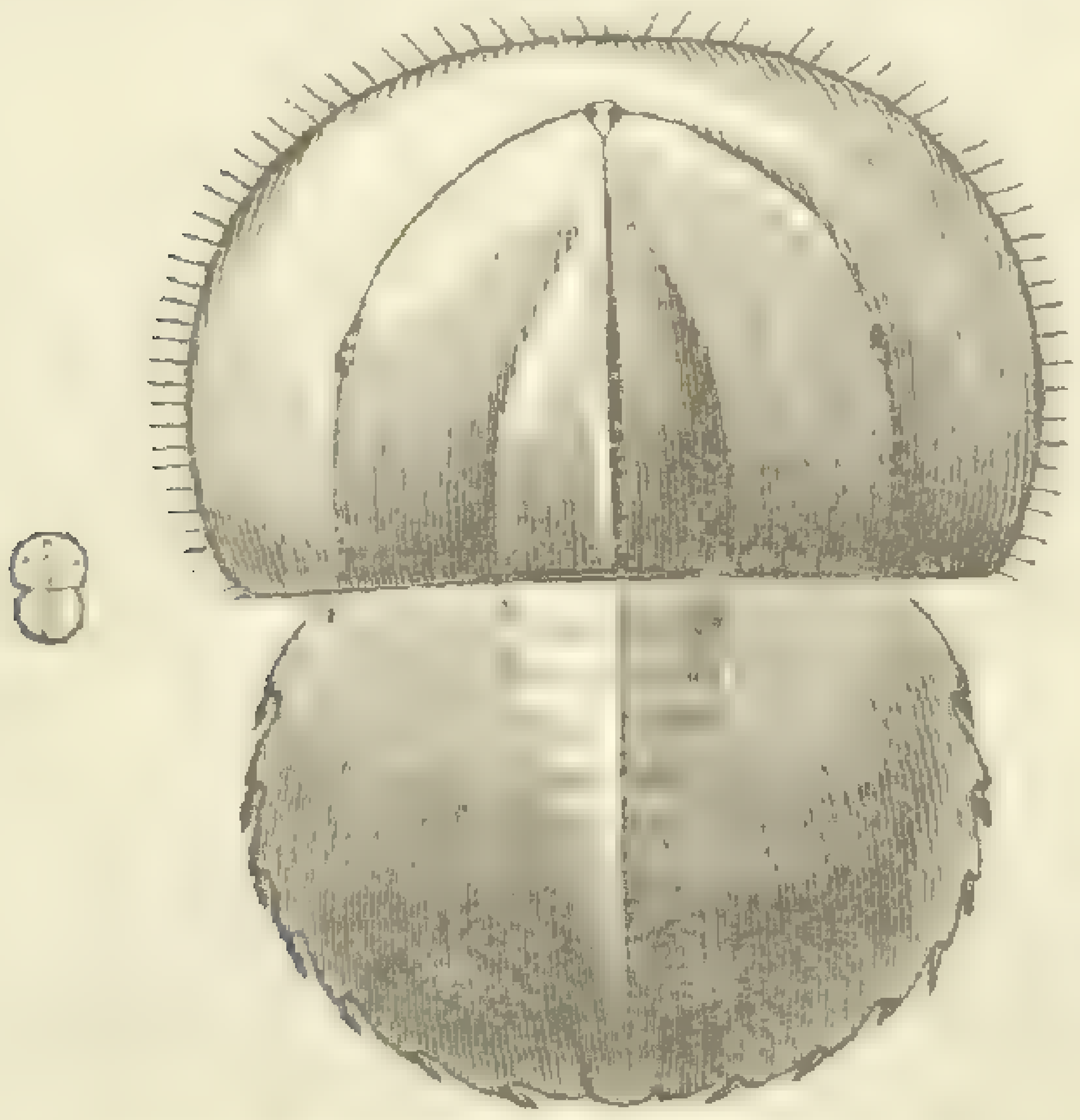
Just before hatching the cephalothorax spreads out, the whole animal becomes broad and flat, the abdomen being a little more than half as wide as the cephalothorax. The two eyes and the pair of ocelli on the front edge of the cephalothorax are distinct; the appendages to the gills appear on the two anterior pairs; the legs have increased in length, though only a rudimentary spine has appeared on the coxal joint, corresponding to the numerous teeth in after life. The trilobitic appearance of the embryo (Fig. 97 top; 98, side view) is most remarkable. It also now closely resembles the Xiphosurian genus *Bellinurus*. The cardiac, or median region is convex and prominent. The lateral regions are more distinctly marked on the abdomen than on the cephalothorax. The six segments of the cephalothorax can, with care, be distinguished, but the nine abdominal segments are most clearly demarked, and in fact the whole embryo bears a very near resemblance to certain genera of Trilobites, as *Trinucleus*, *Asaphus* and others.

In about six weeks from the time the eggs are laid the embryo hatches. It differs chiefly from the previous stage in the abdomen being much larger, scarcely less in size than the cephalothorax; in the obliteration of the segments, except where they are faintly indicated on the cardiac region of the abdomen; and the gills are much larger than before. The abdominal spine is very rudimentary, forming a lobe varying in length, but scarcely projecting beyond the edge of the abdomen. It forms the ninth segment. The young swim briskly up and down the jar, skimming about on their backs, by flapping their gills, not bending their bodies. In a succeeding moult, which occurs between three and four weeks after hatching, the abdomen becomes smaller in proportion to the cephalothorax, and the abdominal spine is prominent, being ensiform and about three times as long as broad. At this and also in the second, or succeeding moult, which occurs about four weeks after the first moult, the young Limulus doubles in size.

Conclusions. The eggs are laid in great numbers loose in the sand, the male fertilizing them after they are dropped. This is an exception to the usual mode of oviposition in Crustacea; *Squilla* and a species of *Gecarcinus* being the only exception known to me to the law that the Crustacea bear their eggs about with them. Besides the structureless, dense, irregularly laminated chorion, there is an inner egg membrane composed of rudely hexagonal cells; this membrane increases in size with the growth of the embryo, the chorion splitting and being thrown off during the

latter part of embryonic life. Unlike the Crustacea generally the primitive band is confined to a minute area, and rests on top of the yolk, as in the spiders and scorpions, and certain Crustacea, *i. e.*, *Eriphia spinifrons*, *Astacus fluviatilis*, *Palæmon adspersus*, and *Crangon maculosus*, in which there is no metamorphosis.

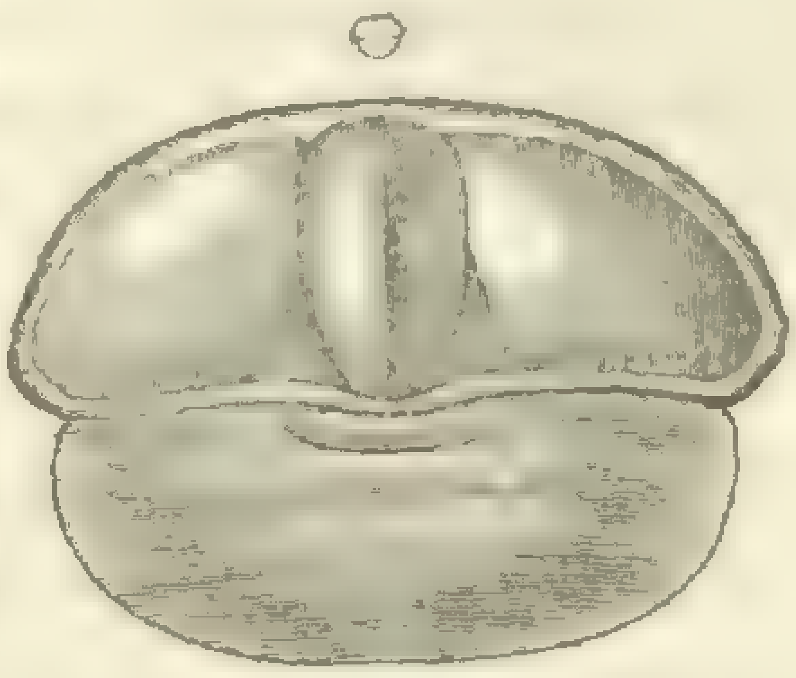
Fig. 99.



Larva of Limulus, natural size, and enlarged.

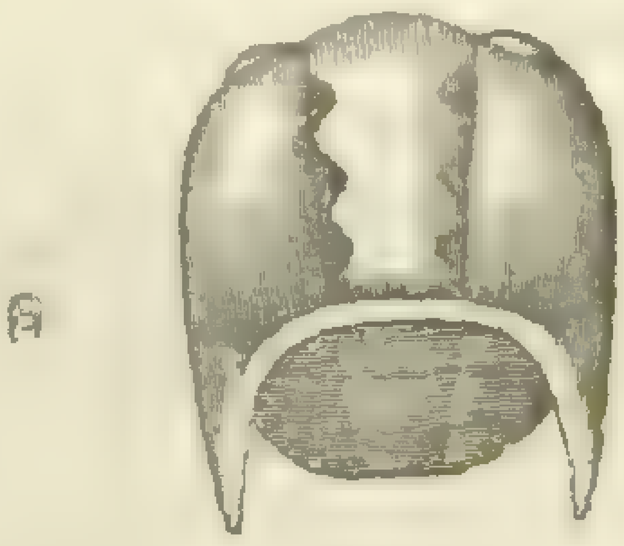
The embryo is a Nauplius; it sheds a Nauplius skin about the middle of embryonic life. This Nauplius skin corresponds in some respects to the "larval skin" of German embryologists.

Fig. 101.



Larva of *Trinucleus ornatus*, natural size, and enlarged.

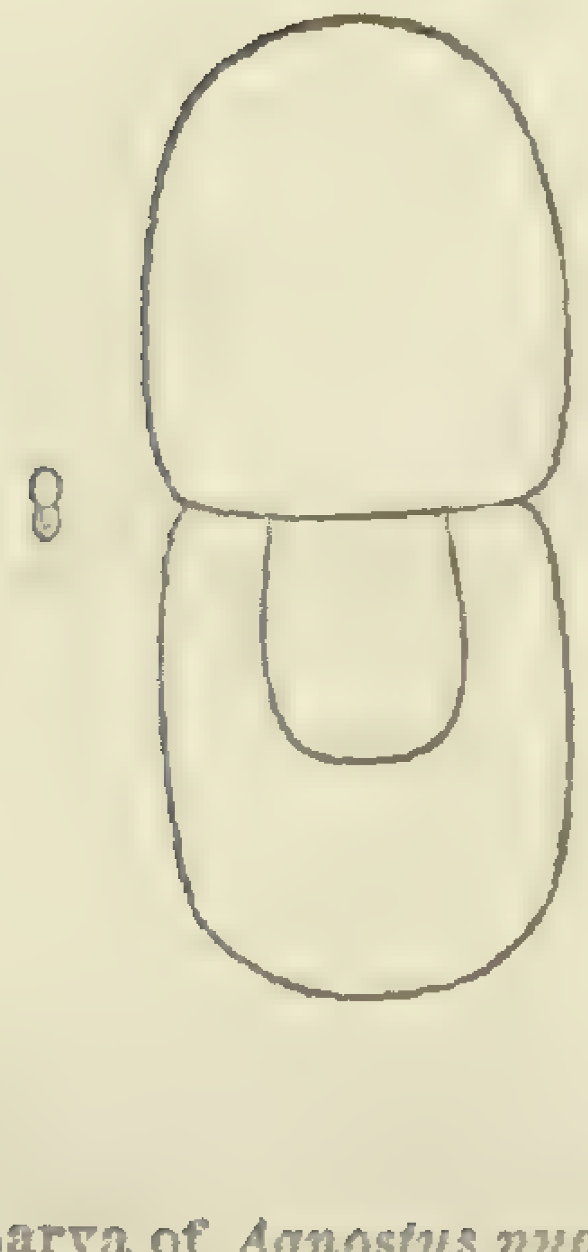
Fig. 102.



Larva of *Sao hirsuta*, natural size, and enlarged.

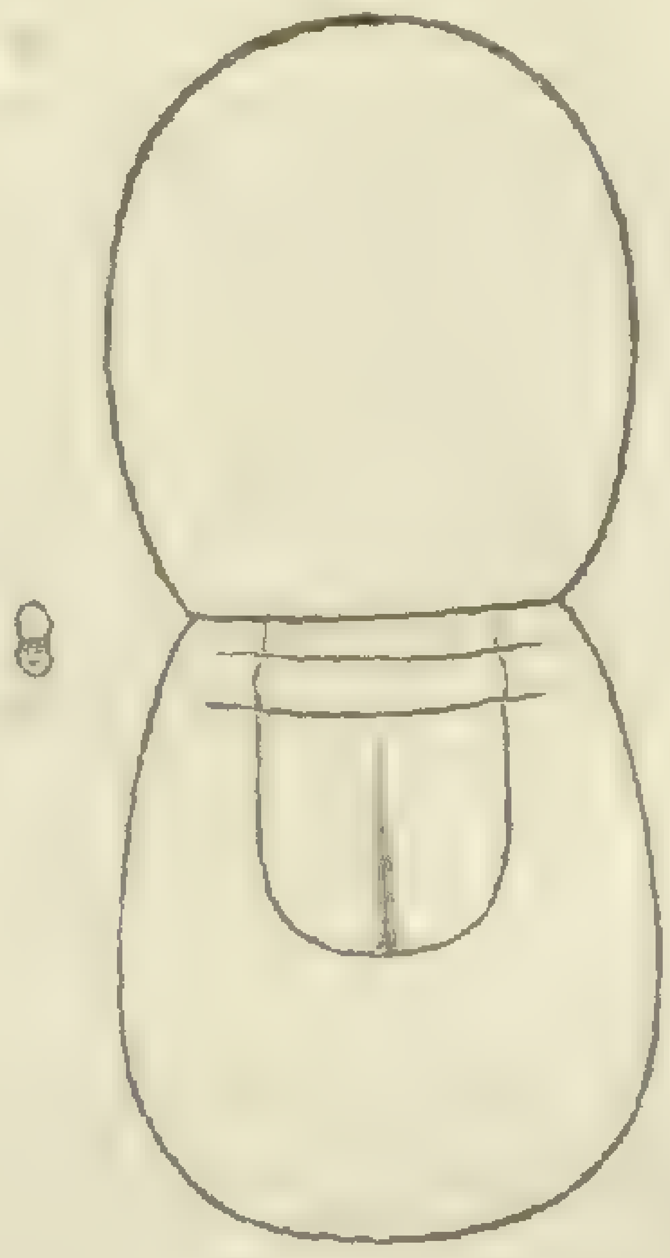
The recently hatched young of Limulus (Fig. 99) can scarcely be considered a Nauplius, like the larvæ of the Phyllopoda, Apus (Fig. 100 *a*) and Branchipus (Fig. 100 *b*), but is to be compared with those of the trilobites, as described and

Fig. 103.



Larva of *Agnostus nudus*, nat. size, and enlarged.

Fig. 104.



Adult *Agnostus nudus*, nat. size, and enlarged.

Fig. 100.

a Larva of *Apus*.
b Larva of *Branchipus*.

figured by Barrande (Fig. 101, larva of *Trinucleus ornatus*; Fig. 102, larva of *Sao hirsuta*; Fig. 103, larva of *Agnostus nudus*) which are in *Trinucleus* and *Agnostus* born with only the cephalothorax and pygidium, the

thoracic segments being added during after life. The circular larva of *Sao hirsuta*, which has no thorax, or at least a very rudimentary thoracic region, and no pygidium, approaches nearer to the Nauplius form of the Phyllopods, though we would contend that it is not a Nauplius.

The larva passes through a slightly marked metamorphosis. It differs from the adult simply in possessing a less number of abdominal feet (gills), and in having only a very rudimentary spine. Previous to hatching it strikingly resembles *Trinucleus* and other trilobites, suggesting that the two groups should, on embryonic and structural grounds, be included in the same order, especially now that Mr. E. Billings* has demonstrated that Asaphus possessed eight pairs of five-jointed legs of uniform size. The trilobate character of the body, as shown in the prominent cardiac and lateral regions of the body, and the well marked abdominal segments of the embryo, the broad sternal groove, and the position and character of the eyes and ocelli, confirm this view. The organization and the habits of Limulus throw much light on the probable anatomy and habits of the trilobites. The correspondence in the cardiac region of the two groups shows that their heart and circulation was similar. The position of the eyes shows that the trilobites probably had long and slender optic nerves, and indicates a general similarity in the nervous system. The genital organs of the trilobites were probably very similar to those of Limulus, as they could not have united sexually, and the eggs were probably laid in the sand or mud, and impregnated by the sperm cells of the male, floating free in the water.

The muscular system of the trilobites, must have been highly organized as in Limulus, as like the latter they probably lived by burrowing in the mud and sand, using the shovel-like expanse of the cephalic shield in digging in the shallow palæozoic waters after worms and stationary soft bodied invertebrates, so that we may be warranted in supposing that the alimentary canal was constructed on the type of that of Limulus, with its large, powerful gizzard and immense liver.

Prof. Gill presented a verbal communication "On the Relations of the Orders of Mammals." He stated that in order to render at once appreciable the course which he had followed in his studies he would enunciate the guiding principles by which he had been influenced. These were five:

1st. Morphology is the only safe guide to the natural classification of organized beings; teleology or physiological adaptation the most unsafe and conducing to the most unnatural approximations.

2d. The affinities of such organisms are only determinable by the sum of their agreements in morphological characteristics, and not by the modifications of any single organ.

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* Proceedings of the Geological Society of London. Reported in "Nature." June 2, 1870. In this communication Mr. E. Billings announces the important discovery of a specimen of *Asaphus platycephalus*, showing that the animal possessed eight pairs of five-jointed feet, widely separated at their insertions by a broad sternal groove.

3d. The animals and plants of the present epoch are the derivatives with modification of antecedent forms to an unlimited extent.

4th. An arrangement of organized beings in any single series is, therefore, impossible, and the system of sequences adopted by genealogists may be applied to the sequence of the groups of natural objects.

5th. In the appreciations of the value of groups, the founder of modern taxonomy (Linnæus) must be followed, subject to such deviations as our increased knowledge of structure necessitates.

The adoption of such principles compels us to reject such systems as are based solely on modifications of the brain, those of the placenta, and those of the organs of progression, such modifications not being coincident with corresponding modifications of other organs, and therefore not the expressions of the sum of agreements in structure.

Commencing with the highest forms of mammals we have, by universal consent, the Primates. This Linnæan order, purged of the Chiroptera referred to it by its founder, includes man, the monkeys, and the lemurs, with their respective allies. It is divisible into two suborders — the Anthropoidea and the Lemuroidea.

The subjects of the next highest group are not so universally recognized, but the Feræ or Carnivora, on account of the nature of the skeleton, the development of the brain, and the organs for the perpetuation of their kind, seem to be most entitled to that rank. This order seems to embrace as suborders the ordinary gressorial Carnivora (Fissipedia) and the Pinnipedia, or Seals, Walrus, etc.

An extinct type — the Zeuglodontes — is related on the one hand to the Seals, and on the other to the toothed Cetaceans. The relation with the latter is, however, the most intimate, and it may be combined with them and the whale-bone whales into one order — the Cete — of which each form represents a suborder. The relations of the order with the Feræ is only masked by the extreme teleological modifications.

Evidently the derivatives from the same stem as the Feræ, the Insectivora, may be placed next in order. The affinity of the Chiroptera to that order is now universally recognized, notwithstanding the extreme teleological modification of its anterior members. The Ungulata are the derivatives from a common stock of a still more generalized type; the development of the brain, organs of generation, etc., indicate their comparatively high rank. Next may be placed the Glires or Rodents, and last of the Placental Mammals, the Edentata, the structure of the skeleton and especially of the skull, the organs of generation, etc., appearing to indicate, with sufficient distinctness, that thus degraded are their rank.

The relations of the subclass Didelphia, with its single order Marsupialia, and of the subclass Ornithodelphia, with another unique order Monotremata are now recognized beyond dispute.

Resuming now the consideration of the sequence by linear series, we may approach by normally specialized forms, the more generalized of each series, and thence in such cases as are necessary diverge in another

direction to the abnormally specialized. We would then have something like the series thus represented on the blackboard (some suborders being omitted), the index hands representing the respective nature and direction of the groups.

Subclass MONODELPHIA.

I.—PRIMATE SERIES.

Order PRIMATES.

Suborder ANTHROPOIDEA. Suborder LEMUROIDEA.

II.—FERAL SERIES.

Order FERÆ.

Suborder FISSIPEDIA. ☜ ☞ Suborder PINNIPEDIA.

Order CETE.

Suborder ZEUGLODONTES. Suborder ODONTOCETE. Suborder MYSTICETE.

III.—INSECTIVOROUS SERIES.

Order INSECTIVORA. ☜ ☞ *Order* CHIROPTERA.

IV.—UNGULATE SERIES.

Order UNGULATA.

Suborder ARTIODACTYLA. Suborder PERISSODACTYLA.

Order HYRACOIDEA. ☜ *Order* PROBOSCIDEA. ☞ *Order* SIRENIA.

V.—RODENT SERIES.

Order GLIRES.

Suborder SIMPLICIDENTATA. Suborder DUPLICIDENTATA.

VI.—EDENTATE SERIES.

Order BRUTA, *or* EDENTATA.

Subclass DIDELPHIA.

Order MARSUPIALIA.

Subclass ORNITHODELPHIA.

Order MONOTREMATA.

Any orders than those admitted seem problematical, and the adoption of an order Bimana for man alone — much more a subclass — seems to be opposed by every sound principle of Taxonomy. There is scarcely a proposition in biology more demonstrable than that man is the derivative from the same immediate stock as the higher anthropoid apes, and probably after the culmination to nearly the same extent as at present of the differentiation of the order into families and subordinate groups.

Professor A. WINCHELL read "Notes on some Post Tertiary Phenomena in Michigan." This paper was intended simply to make note of three classes of phenomena recently observed in Michigan.

The first note was in reference to the relics found in and beneath the numerous peat beds of the state. These beds are the sites of ancient lakelets that have been slowly filled by the accumulation of sediments. They inclose numerous remains of the mastodon and mammoth. These are sometimes found so near the surface that one could believe they had been buried within five hundred or a thousand years. For the first time, too, the remains of the gigantic extinct beaver of North America (*Castoroides Ohioensis*), have been recently found in Michigan. What is perhaps most interesting of all, is the discovery of a flint arrowhead in a

similar situation. This arrowhead was found seven feet beneath the surface in a ditch excavated in the southern part of Washtenaw county. The mastodon remains found near Tecumseh, but a few miles distant, lay but two and a half feet beneath the surface. The Adrian mastodon was buried but three feet deep.

The second note related to the occurrence of enormous beds of bog iron in the upper peninsula of Michigan, on the tributaries of the Monistique river. It occurs in a half desiccated bog covering several townships. It is of remarkable purity, and of great but unknown depth. It lies directly in the track of the projected railroad, intended to connect the North Pacific Railroad with the railroad system of Michigan. The ore can be floated down the Monistique and its tributaries, to Lake Michigan, in the immediate vicinity of an excellent harbor. This immense deposit is undoubtedly derived from the desintegration of the hæmatites and magnetites of the contiguous region on the West. The ore will possess great value for mixing with the other Lake Superior ores.

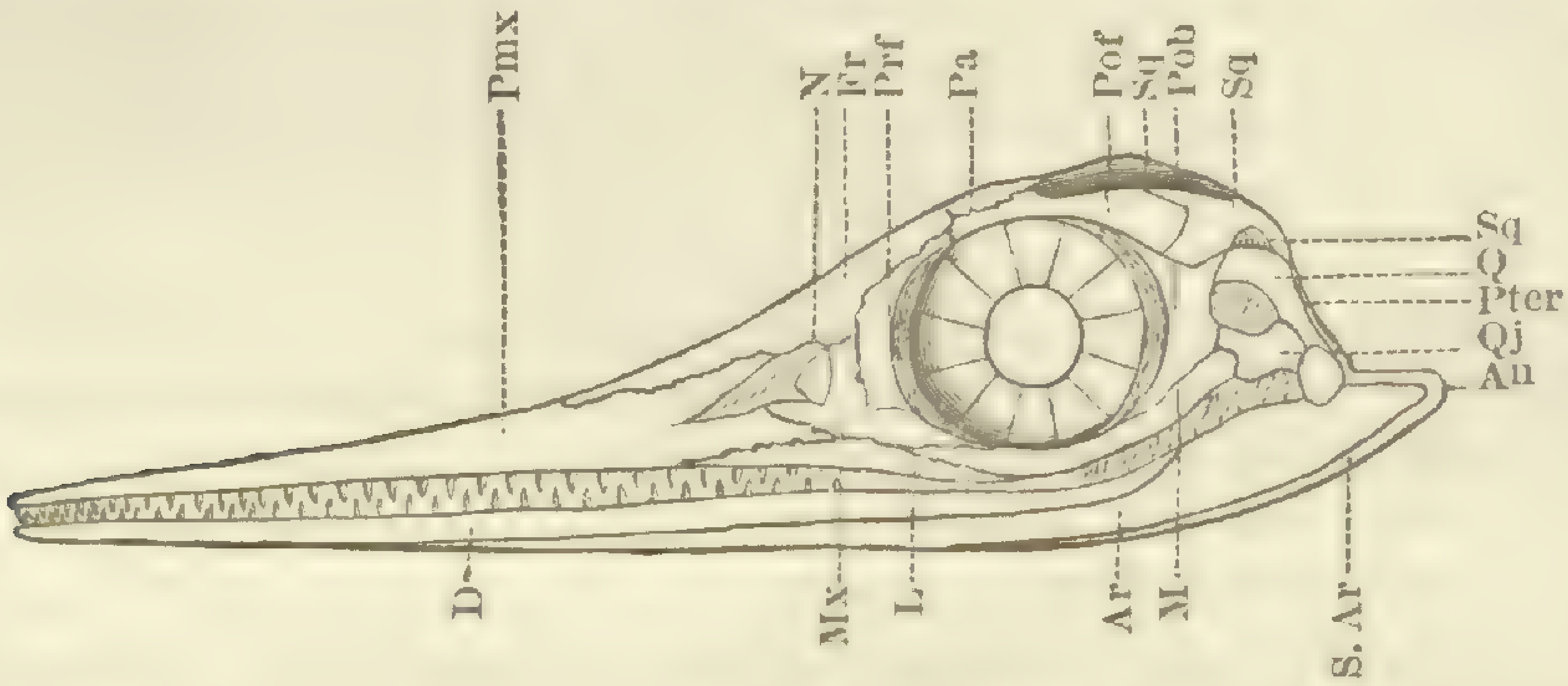
The third note was on the discovery of an ancient outlet of Lake Superior. Following the White Fish river from the head of Little Bay de Noc, we find it occupying a broad and deep valley walled in on both sides by limestone cliffs attaining an elevation of one hundred and twenty feet. The head waters of this river literally interlace with those of the Au Train river, which runs north into Lake Superior. Here is a vast valley of erosion but little elevated in any part above the present level of Lake Superior. Through this the waters of that lake must have flowed in a powerful stream in that earlier epoch when all the lakes stood from fifty to three hundred feet higher than at present. There are many evidences of glacier action along this valley. The striæ at Marquette, near the head of the valley, point North and South. In short, the evidences lead to the conviction that a vast glacier stream once traversed this valley and was probably the agency by which it was excavated. Little Bay de Noc is but the prolongation of this valley at a lower level; and, indeed, the whole basin of Green Bay seems to be but a phenomenon of erosion belonging to the epoch of the same glacier system.

Prof. E. D. Cope read a paper "On the structural Characteristics of the Cranium in the lower Vertebrata (Reptiles, Batrachia and Fishes)," giving a new systematic arrangement of the Reptilia, and determining for the first time the structures of the posterior regions of the crania in Dicynodons and Ichthyosauri.

He first pointed out the homologies of the squamosal bone, stating that it was to be recognized as the posterior half of the zygomatic arch. The zygomatic and quadratojugal are the two cranial arches which have occasionally been mistaken the one for the other, for example in the Ichthyosaurus and Sphenodon, by their describers. The squamosal was shown to be present in all reptiles except the serpents, and to be homologous, or identical, with the "temporo-mastoid" of the frog, and the preoperculum of osseous fishes, by comparison with Lepidosiren. This was proven by

the development of this element in the Dicynodons and Ichthyosaurus, where it had heretofore been erroneously determined. Thus in Ichthyosaurus it was the "supratemporal" of Owen, and besides forming the posterior half of the zygomatic arch it descended posteriorly to about opposite the middle of the posterior face of the os-quadratum. Further, it had an extensive development on the inner face of the temporal fossa reaching round nearly or quite to the postfrontal, and sending down a columella to the pterygoid. This supero-anterior portion was the parietal of Owen. The true parietal was in advance of this, and embraced the usual fontanelle, while the frontals were the nasals of Owen. The

Fig. 105.*



true nasals he recognized in small bones, one at the posterior extremity of each exterior nostril.

Turning to the Dicynodont genus Lystrosaurus, he stated that the form of the squamosal bone was very similar to that seen in Ichthyosaurus, but that it extended postero-inferiorly much further. It concealed the quadratum when viewed from behind; the latter was small and occupied a position at the inferior extremity on the intero-anterior side of the squamosal, and was attached to the pterygoid inwardly. He thought that this structure bore an analogy to that seen in the Batrachia, where the quadratum is similarly concealed. He thought the bone in the Anura, Urodela, and Dipnoi, which Huxley had suggested was the preoperculum of the Teleosts, was truly the squamosal of the higher vertebrata.

He further pointed out that Lystrosaurus possesses a columella having a superior origin quite similar to that of Ichthyosaurus. The distinctness of the proötic was pointed out as Chelonian and Lacertilian, and the presence of the parietal arches as distinct from the opisthotics was insisted on, they having been united by Owen. He then gave new deter-

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* Fig. 105.—Ichthyosaurus; lateral view (from specimen from Barrow, Leicestershire).

Pmx. . Premaxillary bone.
Mx. . . Maxillary.
N. . . . Nasal.
Fr. . . . Frontal.
Prf. . . Prefrontal.
Pof. . . Postfrontal.
Pa. . . . Parietal.
L. . . . . Lachrymal.
M. . . . Malar.
Qj. . . . Quadratojugal.
Q. . . . . Quadrate.
Pob. . . Postorbital.
Sq. . . . Squamosal.
D. . . . Dentary.
An. . . . Angular.
Ar. . . . Articular.
S. Ar. . Subarticular.
Pter. . Pterygoid.

minations of the opisthotic bone in the various orders of reptiles, rectifying errors which existed in modern works on comparative anatomy. He considered the suspensorium of the Ophidia to be the opisthotic and not the squamosal as given by Huxley, explaining it by reference to figures of those regions in Clidastes and Cylindrophis. In the first genus the element in question bears the squamosal on its extremity as in the Testudinata, and in the latter it forms part of the cranial walls, being supported by the exoccipital and proötic, as in Clidastes. The remarkable enlargement of the ear bones in the same groups was then described, and the homologies with the metapterygoid and symplectic of fishes and quadrate of reptiles, and of the anvil with the hyomandibular of fishes, as pointed out recently by Huxley. He pointed out a bone in Ichthyosaurus which he thought might be the hyomandibular. It is postero-interior to the quadrate, and below the opisthotic. He had not found it

Fig. 106.*

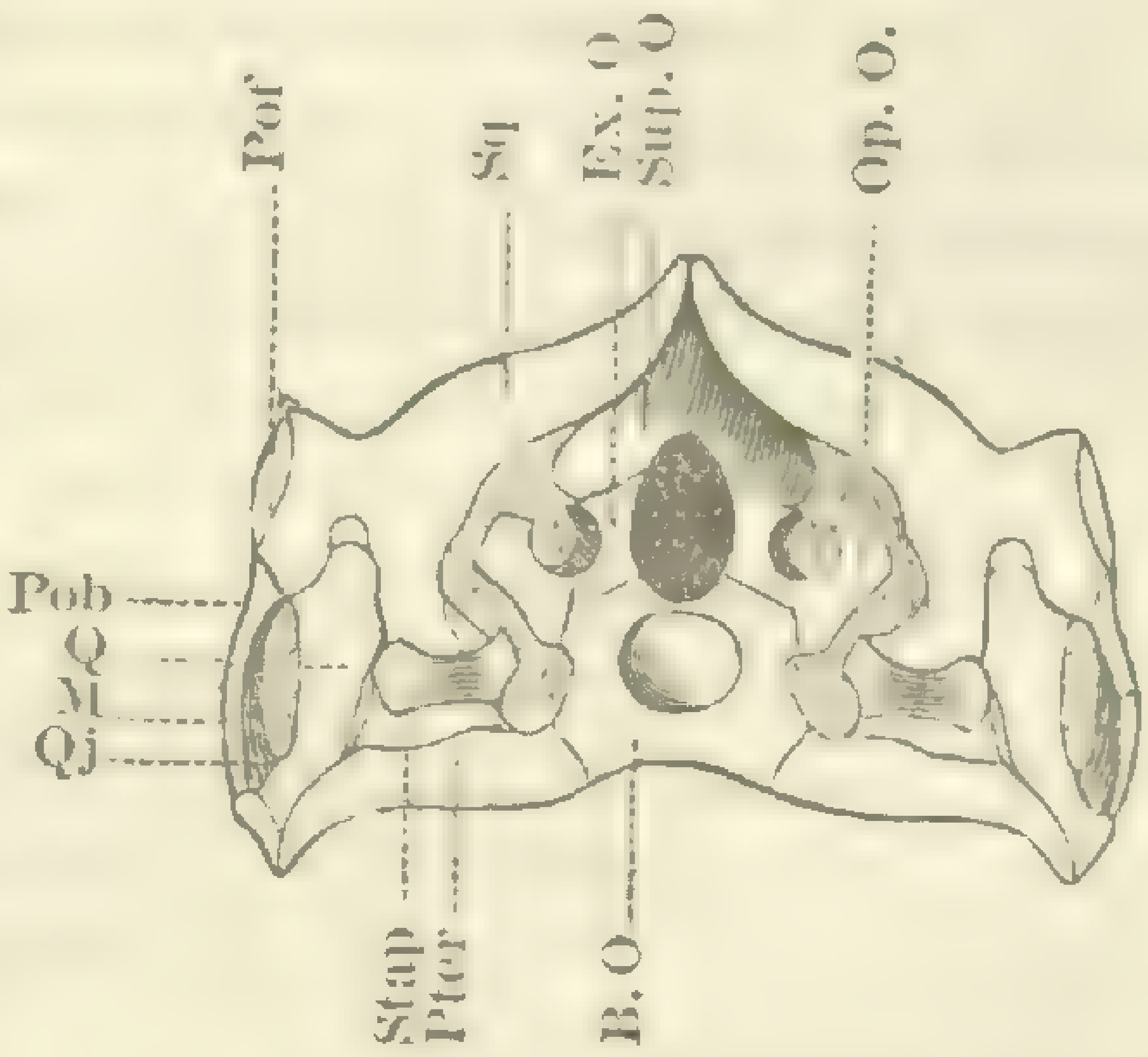
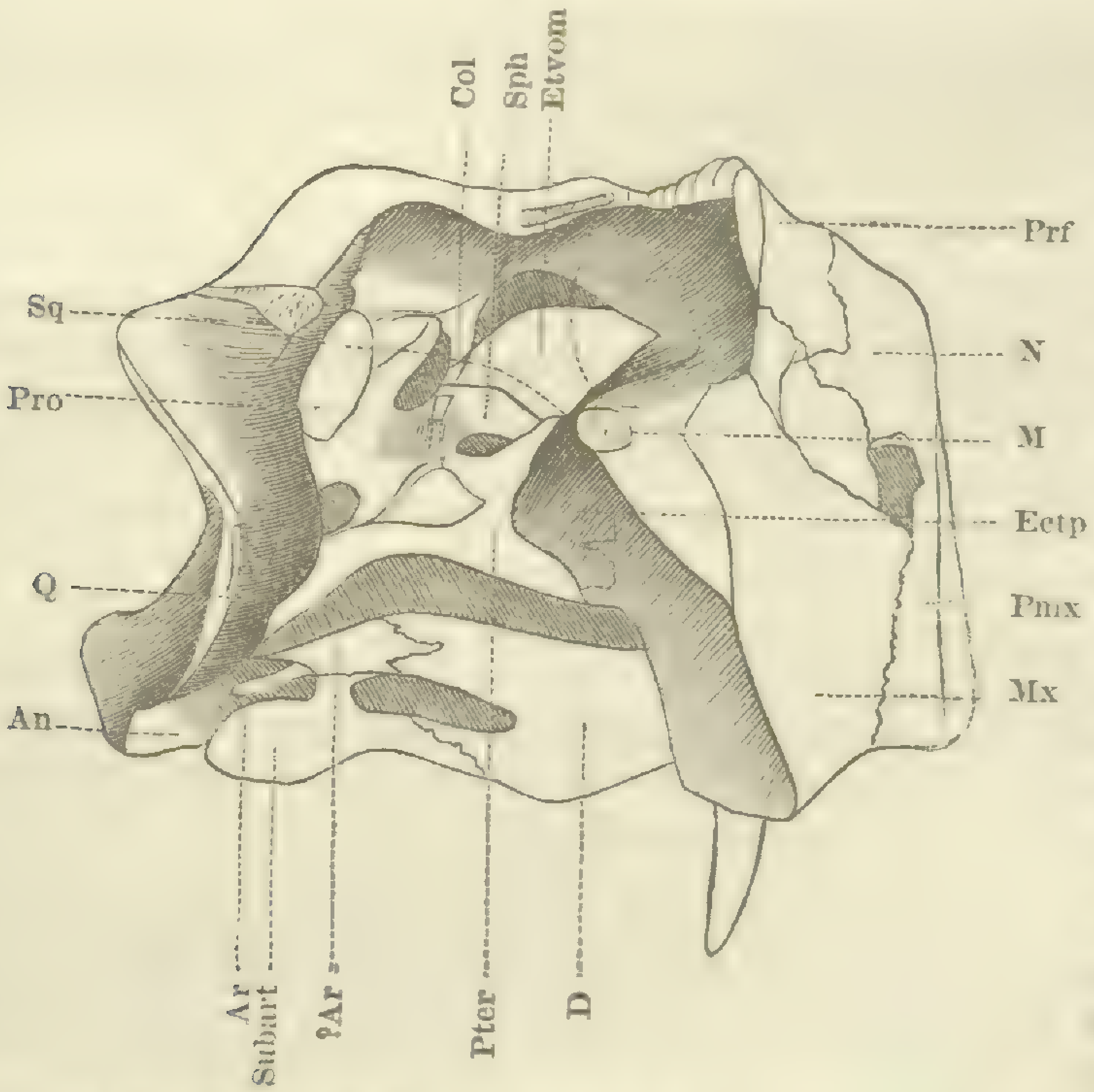


Fig. 107.†



* Fig. 106.—Ichthyosaurus; cranium; posterior view. Lettering the same as in 105 with the following additions:—

B. O. . . Basioccipital.
Ex. O. . Exoccipital.
Sup. O. Supraoccipital.
Op. O. . Opisthotic.
Stap. . . Suprastapedial or hyomandibular.

† Fig. 107.—Lystrosaurus frontosus (from Cape Colony): profile. Lettering as in 105 and 106 with the following additions:—

Etvom. . Ethmovomerine.
Sph. . . . Sphenoid.
Pro. . . . Prootic.
Pter. . . Pterygoid.
Col. . . . . Columella.
Ectp. . . . Ectopterygoid.
Subart. . Subarticular.

described. He thought that the element in Ichthyosaurus, called by authors the squamosal, was really the quadratojugal.

He next pointed out the various origins of the columella, a bone peculiar to reptiles, and designed to support the roof of the cranium. In Ichthyosaurus and Dicynodon it originated from the squamosals, in tortoises from the parietal, in crocodiles from the alisphenoid, and in lacertilia the origin could not be discovered.

He spoke of the proposition of Huxley, that some of the earlier types of reptilia in geologic time were not more generalized than those now existing. He took exception to this, and stated that the Dicynodon, among the earliest of the groups (Triassic) was the most generalized. Thus he showed it had five characters of Ichthyopterygia, three of Testudinata, two of Rhynchocephalia, three of Dinosauria, one of Lacertilia, and one of Crocodila.

The system of Reptilia proposed was the following:

(A). Attached quadrate.

I. Parts of extremities not differentiated; ribs two headed to centrum. . . . . . . *Ichthyopterygia.*

II. Extremital parts differentiated:

1. Head of rib sessile on centrum tubercle to spine. . . . . *Testudinata.*
2. Capitular surface on centrum, tubercular on neural arch. . . . . *Archosauria.*
3. Capitular and tubercular united, rising to neural arch. . . . . *Synaptosauria.*

(B). Quadrate, free, mobile.

1. Ribs double headed; a quadratojugal. . . *Ornithosauria.*
2. Ribs single headed; no quadratojugal.

(a). No alisphenoid; a columella; opisthotic, all at-attached; feet. . . . . *Lacertilia.*

(b). Alisphenoid, no columella; opisthotic fixed, styloid; paddles. . . . . *Pythonomorpha.*

(c). Alisphenoid; no columella; opisthotic, free, mobile. . . . . *Ophidia.*

Mr. J. B. Perry read a paper on "The Supposed Elevation and Depression of the Continent during the Glacial Period." Many geologists have supposed an elevation of the northern part of the continent necessary in order to the existence of the Ice Period, and of the phenomena peculiar to it. Without resorting to a supposition of this kind wholly unauthorized by positive evidence, we may invoke certain astronomical facts which, in their combination, were perhaps sufficient to produce this great winter of the ages. Intense cold being thus occasioned by cosmical influences, the formation of an ice sheet of vast extent would naturally follow, especially if there were abundant moisture. The fact of intense igneous activity, near the close of the Tertiary Period, suggests the occurrence of immense evaporation, and thus a source of aqueous supply. An ice-

sheet might thus be formed. Great cold prevailing on its northern limits and serving as a barrier to its motion in that direction, there being at the same time a partial melting of its southern face, the waters from the wasting snows on its surface percolating the icy mass, there also being contractions and expansions consequent upon alternations in the temperature; all these being connected with the gravitating force of a mass from five thousand to ten thousand feet in thickness, motion to the south would inevitably result, even on a horizontal surface, and much more if there were a southward inclination of the country. Under these circumstances we have an instrumentality fully able to plane, smooth, and striate the rocky floor of the continent as it now appears, and thus to account for the debris almost everywhere met with in great abundance.

But if there were no elevation of the country, how are we to explain the occurrence of pot-holes in places apparently never traversed by torrents; the formation of fiords; the existence of sub-marine river-channels, as those extending from the mouths of the Hudson and the Connecticut; or the fact of sub-aërial deposits, as mud-flats, now found beneath the level of the ocean? It is well known that, when glaciers meet with obstructions, breaks (known as *moulins*) occur in them; that the snows melting on the surface of the ice-mass, streams are formed, which flow into these breaks, and thus become torrents and cascades, which wear pot-holes in every respect similar to those requiring explanation. Again it should be remembered that such an ice-sheet moving seaward must, in displacing the waters along the shallow margin of the ocean, do its legitimate work of erosion, and that thus old depressions would be deepened, while new valleys and fiords would be formed, as well as sub-marine river-channels, which remain to this day. Accordingly all this erosion might readily take place without an elevation, even if the sea were at its present height. But this leads us to ask, whence came the immense ice-sheet; undoubtedly for the most part from the ocean. Thus its waters must have undergone a great depression, perhaps one of several hundred feet; and this enables us to account for the mud-flats and other like deposits, which were probably laid down when the ocean was at a lower level than it is to-day.

It has been, moreover, thought necessary to suppose that a depression of the continent finally followed its conjectured elevation. The land having been lifted up, it must be got down again, in order that there might be a return of warmth, and things be as we now find them. Now marine organic remains seem to attest a depression, in some places, of about five hundred feet. But so slight a submergence of the land, there being upon it an ice-sheet thousands of feet in thickness, could not cause a return of warmth, while the cosmical agencies already referred to are abundantly sufficient for the production of such an effect. This summer of the ages thus coming on, the ice-sheet as gradually melting must retreat northward. And the waning of the glacial mass would be accompanied by results which require an explanation.

The ice thawing, the detrital matter which lay beneath it, and is now known as typical drift, would be laid bare and left substantially as we find it. In this view a resort to a depression of five thousand or six thousand feet, and to iceberg agency, is unnecessary. Indeed, Arctic icebergs could not furnish the material of New England typical drift, since it is for the most part of local origin; while bergs of ice from the White Mountains could not have supplied it, for it is a continuous sheet, having a uniform glaciated character, spreading over vast areas lying far to the north of these mountains. So icebergs could not have deposited it, because, as they slowly wasted, the particles of matter must have been scattered by the flux and reflux of the tides, and thus to a large extent stratified. Again, from the southern border of the wasting ice-sheet, floods of water would flow, working over and remodeling portions of the detrital masses, bearing some of the finer material southward, and laying down those deposits known as modified drift. These constitute in part the terrace formations, which usually slope with the rivers along which they occur. In some instances there were barriers obstructing the waters; thus were formed ponds and lakes, in which deposition took place in more nearly horizontal layers. Finally from the wasting of the ice-sheet the surface of the ocean must be elevated, its waters spread over the lower levels of the still slightly depressed lands, laying down beds containing marine organic remains, which to-day bear witness of a partial depression. In due time, after the disappearance of the ice-sheet, the continent would resume its normal elevation, the brackish waters of the ocean be excluded, and all things come gradually to take the position in which we now find them.

In conclusion it may be asked whether the explanation suggested be not in consistency with the facts, and thus whether we ought not to accept it, rather than arbitrarily to resort to the assumption of a vast continental elevation and depression, which if not disproved, is at least unsupported by positive evidence.

Mr. Dall described three new generic forms of Brachiopoda, principally from the collections of the United States Exploring Expedition. Two of these belonged to the group of articulated Brachiopods, while the third was that animal, which, under the name of Lingula, had just been described by Mr. Morse. Mr. Dall then spoke of several special points of structure, especially the peduncle of Lingula, demonstrating its construction to be analogous to that of the siphons of bivalve mollusks, such as the common clam, *Mya arenaria*. He then described the bristles of Lingula, showing that they were quite different in construction from those of the worms, and also that the Chitons were (in some genera) provided with true follicular setæ, proceeding from the mantle. Hence these characters cannot be held to afford satisfactory evidences of affinities with Annelids. Mr. Dall then proceeded to discuss the theory of Mr. Morse, that the Brachiopods were a subdivision of the Annelids. Mr. Dall took the opposite view, and, while admitting all the facts

brought forward by Mr. Morse, and fully appreciating the careful and thorough nature of his researches, contended on the other hand that these facts were susceptible of quite another interpretation.

Mr. Dall then went on to take up, one by one, the circulatory, nervous, muscular, and digestive systems of the Brachiopods, and to compare each with the same organs in the Annelids and the Mollusks, and came to the conclusion that the weight of structural characters was essentially of a Molluscan nature. The Mollusks were an individualized type, while the Annelids, and even most of the Articulates were typified by their repetition of similar organs No such repetition obtains among the Brachiopods. Mr. Dall was of the opinion that the Molluscoidea should rank as one of two great primary divisions of the Mollusca — one, the true Mollusks, typified by the Gasteropoda, and second the Molluscoidea, typified by the Brachiopoda. The second division would include the Polyzoa, Tunicata, and Brachiopoda, and Mr. Dall was of the opinion that these groups were essentially related to one another, and cannot be separated without violence to their affinities.

In reply to Mr. Dall's communication and objections advanced, Prof. Morse replied in brief as the time for adjournment had passed. He would only take a few moments in correcting some points in which Mr. Dall had evidently misunderstood the general articulate characters claimed for the Brachiopods. In this respect his demonstration of the striated muscular fibre in the Brachiopods accorded well with the views advanced, inasmuch as striated muscular fibre is a great characteristic of the crustacea, and does not occur in the mollusks. Mr. Dall did not know of any tubicolous worms having a blind intestine. Professor Morse referred him to certain worms in the inferior groups. His views on Chiton were rather strange, seeing that Chiton presented articulated characters in its development, the presence of a dorsal vessel, the terminal opening of intestine, and the forward opening of oviducts. As to a comparison between the peduncle of Lingula and the syphonal tubes of Mya, the relations were so different that they could not enter the discussion whatever. The related points, as indicated by the structure of the oviducts, were not properly appreciated by Mr. Dall. He referred to the figure still kept upon the board as presenting all the points involved, and would demand a molluscan character in the Brachiopods. He then carried out the points raised by Mr. Dall, by citing other mollusks, with strong articulated features, which Mr. Dall had overlooked.

Mr. Thomas Meehan read a paper "On the Laws of Fasciation, and its relation to Sex in Plants." He said that in trees, branches often came out in thick masses, which botanists called "fasciations," and the people "Crow's Nests." An over supply of nutrition was the received theory of their origin. He believed the reverse to be the fact. In proof of this he stated that the shoots forming the bunch of branches never grew as vigorously as the others, the leaves were of a paler hue, and in evergreens, the leaves were deciduous. Many of the shoots died in severe winters.

All these results were due to imperfect nutrition, the effect of which was a low state of vitality. That weakness produced the fascicle was also proved on the theory propounded in his Chicago paper, "Adnation in Coniferæ." There it was seen that distichous leaves in coniferæ came only with increased vigor of growth. The leaves were less free from cohesion with the stem in proportion as vitality was low. Here were the same facts. The leaves on the fascicle of the Balsam Fir were of the same nature as the weak leaves described in the paper referred to. Mr. Meehan had also shown, at the Salem meeting, that sex was influenced by the condition of vitality. The male sex followed from a loss of vigor. Here the same law followed fasciation. The fasciated bunches in the Blackberry, produced foliaceous calyx sepals; and where the bunches were of numerous branchlets, an increase of petals followed. In a variety known as Willson's Early, the number of branchlets in the bunch was often greater than in other instances. Then the female organs were nearly all aborted, and the flowers were completely *double*. Thus proving at once that weakness was unfavorable to the female sex, and proportionately favorable to fasciation. The conclusion reached, was that fasciated branches, or "Crow's Nests," are the consequence of impaired nutrition or vitality.

Mr. Thomas Meehan read a paper "On objections to Darwin's Theory of Fertilization through Insect Agency." He said that the discoveries of Darwin had disclosed wonderful apparent arrangements for fertilization through insect agency; but occasionally instances were found where with the most perfect facilities insects seemed to make no use of them. These had been considered as objections to a full acceptance of Mr. Darwin's theories. The Salvia was an instance. The lower division of the anther acted as a petaloid lever, closing the throat of the corolla tube, which *ought* to throw the pollen on the back of the bee when it entered for the honey. The principle was perfect. *But no insect is seen to enter.* On the other hand the Humble Bee, "without which," Darwin says, "some species would die out in England," bores a hole on the outside, through which it gets the honey. The Humble Bee thus seems to avoid its duty here. A similar state of things exists in the Petunia of our gardens. The humble bee extracts the honey by making a slit in the tube, and avoids interference with the pollen. But Mr. Meehan found that these flowers are the favorite resort of Sphinx's and other night moths, which do extract the honey from the mouth of the tube, and thus cross fertilize. It would thus seem that plants not only do as a rule prefer fertilization by insect agency, but probably some classes of flowers have their preferences for certain classes of insects. In the case of Salvia, probably some insects peculiar to their native countries, fertilize them; especially is this probable, as in cultivation the Salvia produces very little seed.

THE

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THE HABITS AND MIGRATIONS OF SOME OF THE MARINE FISHES OF MASSACHUSETTS.

BY JAMES H. BLAKE.

Fig. 108.

The Mackerel, *Scomber vernalis.*

THE part of Natural History relating to the habits of fishes is far behind other branches of this study, comparatively little being known of this interesting subject. The reason of this is plainly understood when we consider how small is the number of persons interested in such studies, who have the opportunity of observing the fishes a sufficient length of time to enable them to gain any great amount of information concerning them. Those who have the opportunity for gathering such information are of the class who look more to the financial profit from this business than to the benefit in knowledge they may gain. There is fortunately another class of individuals, who, while striving for their own maintenance, are careful to record the numerous

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interesting facts which come under their observation; but, unhappily for science, this class is too small to occupy the field, and consequently we are kept in ignorance of this important matter.

The migration of the fishes on our coast may, in a measure, be compared to that of the birds on the land, both being governed by the seasons. The song birds, for instance, which frequent our villages during the summer and attract our attention by their musical strains, we greatly miss during the winter months, and we know that they have gone to parts where the temperature is better adapted for their subsistence and comfort. Those who reside at the seashore all the year observe movements among the fishes similar to those seen in the birds, and the time when each species of fish that is of value to the fishermen will make its appearance in any particular locality on the coast is practically known. Nearly all the fishes change their habitat as the different seasons advance, some by going to more northern or southern latitudes, while others move simply from deeper to shallower water, and *vice versa* to find the temperature they require.

There are no fish which remain in one and the same locality or fishing-ground the year around. Consumers of fish are acquainted with the fact that all our marketable fishes are found at a regular and limited period in our markets.

The Mackerel (*Scomber vernalis*), Fig. 108, come into the shallow water near the land directly from their winter habitat, the deep water of the Atlantic, during the months of May and June, and their annual appearance is very regular. They approach the coast for the purpose of spawning, and on reaching a favorable situation, immediately deposit their eggs, and leave them without farther protection. The number of eggs deposited in one season by each female is estimated to be between five and six hundred thousand. After spawning the fish move northward, following the line of the coast till they are checked by the chill of the water, when they return, and, in the month of November, seek the deep

water again. Those mackerel which first come in contact with the land at Cape Cod will migrate as far as the northern part of the coast of Maine. They are not easily caught with the hook during their spawning season, and it is at this time that "gill-nets" are used to the best advantage. The mackerel at this time are very lean, and the flesh has a darkish appearance, while at the time of their departure from the coast they are flat and plump, and are then considered to be in the best condition for food, and consequently bring the highest price.

In comparing the number observed in one season with another the difference may be very great, but on the whole they cannot be considered as either increasing or decreasing in numbers. Some seasons they will be very plentiful, and schools of them may be seen near the surface of the water one or two miles in extent. When seen thus manœuvring in such great abundance they will not allow themselves to be taken with the hook very extensively; it is then that the purse-seines are used to the best advantage in capturing them. At other times, perhaps the following day, the fish will be entirely unobservable in the water, but when "tole-bait" is thrown over to "raise them," they will perhaps soon be seen by the side of the vessel in vast numbers, and will readily take the hook. Sometimes a crew of fifteen men will catch over a hundred barrels of them in a few hours. In those years when many fish are seen it has been observed that they are small, and that in those seasons in which the number is less they are large. This is probably owing in part to the number destroyed when young, and in part to the fact of a larger number than usual spawning on the outer banks.

Mackerel are always on the move and migrate in schools. In the spring, when they are caught in gill-nets, the quantity taken in the different nights varies considerably. Fishing with "drift-nets" is practiced in the night, for the fish cannot be caught in this way in the daytime, as the net is then

easily seen by them and avoided; they also swim deeper during the day, and would thus pass under or below the nets. The fishermen cast their nets about dusk; soon after, the fish are observed in them, and often before ten o'clock in the evening the nets will contain thousands of mackerel. The fishermen may visit the same locality the following night and be very unsuccessful, while the reports from other boats will show that the greater proportion of the fish were in another direction, and also that they move constantly and in large schools.

Mackerel, like most fishes, have their choice in respect to food. This consists of the young of other species and of

Fig. 109.

The Codfish, *Morrhua Americana.*

crustacea. The "tole-bait" consists chiefly of Menhaden (*Alausa menhaden*) ground very fine, with which clams are sometimes mixed, as they are believed to improve its quality. The bait commonly used for the hook is a piece of white skin cut from the throat of a mackerel, but when they are abundant and ferocious any white material will do; sometimes a small silver coin is used, and it is not uncommon for them to be taken on the bare hook.

The Codfish (*Morrhua Americana*), Fig. 109, is another familiar marine species, but one which differs very considerably in its habits from the mackerel. It is found in our markets all the year, but is not taken at all times from the

same locality or fishing-ground. This fish does not migrate along the coast, but acquires its desired temperature by gradually moving from shallower to deeper water, and returning as the season grows colder. Nearly all fish which go in schools migrate more or less along the coast after coming from the deeper water, while those which are distributed over the bottom, as the Cod, Haddock, etc., do not migrate except from shallower to deeper water.

Codfish visit the shallow water of Massachusetts Bay to spawn about the first of November, and towards the last of

Fig. 110.

The Haddock, *Morrhua æglefinus.*

this month deposit their eggs on the sandy banks and rocky ledges.* About eight or nine millions of ova are annually deposited by each female. The codfish remain in the vicinity of their eggs till June, when they again retire to deeper water, the shallow water having become too warm for them.

The codfish, like the mackerel, takes no care of its eggs, and only a small portion of these ever arrive at maturity. Nature so regulates the destiny of these eggs that only a portion of them are permitted to mature, otherwise the

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* G. O. Sars of Christiania, Norway, has observed that codfish deposit their spawn at the surface of the water, where the ova float throughout the whole of their development. He has followed up the development of the egg, and of the young, during the first fortnight after exclusion. The embryo leaves the egg on the 16th day. See Günther's Zoological Record for 1868. — EDITORS.

codfish would soon monopolize the whole ocean. These eggs are eagerly devoured as food by the various animals which inhabit the bottom, and the proportion of eggs destroyed in this and other ways cannot be readily estimated, but we know it must be enormous by the comparatively few young fish we see. If, during its stay in shallow water, the weather should suddenly become cold, and so remain for two or three days, the codfish immediately retreats to water of some forty fathoms in depth, and does not return till the temporary change has passed; then they gradually seek their

Fig. 111.

The Bluefish, *Temnodon saltator.*

former resort, which is a depth of fifteen or twenty fathoms. The Haddock (Fig. 110) at such times likewise retreats, but does not so soon return to its former station.

The quantity of codfish annually taken does not differ so much in the different years as does that of the mackerel, yet the amount is somewhat variable. The cause is the same in both cases, but as the codfish has a shorter distance to come the annual number is naturally less variable. The number of codfish existing at the present time does not appear to differ from that of twenty or more years ago, and I think we are safe in assuming that there has been no perceptible diminution for a century.

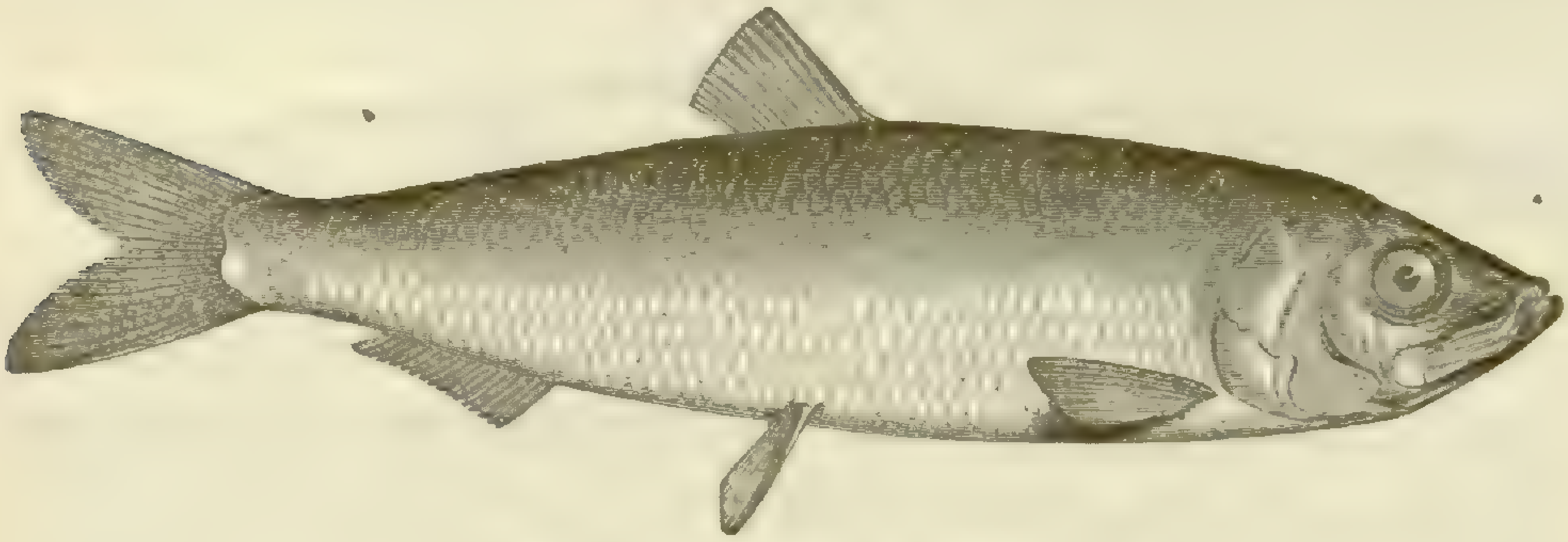
The food of the codfish consists of smaller fish, mollusks and crustacea. The bait considered by the fishermen as best adapted to their tastes are the common Herring (*Clupea elongata*), squid, etc., but clams (*Mya arenaria* and *Mactra*

solidissima) are more generally used, as only this bait can be obtained at all seasons of the year; clams are also found to remain longer on the hooks.

Nearly all the codfish obtained on our coast are brought to market in an unsalted condition, but they form only a small portion of the number sold in Massachusetts. The majority of the codfish sold here are brought from the Banks of Newfoundland and other great banks, and are always brought in a salted state.

We have already stated that although many hundred thousands of mackerel and codfish are captured through the agency of man, and many more are destroyed by other influences, there has been, notwithstanding, no noticeable change

Fig. 112.



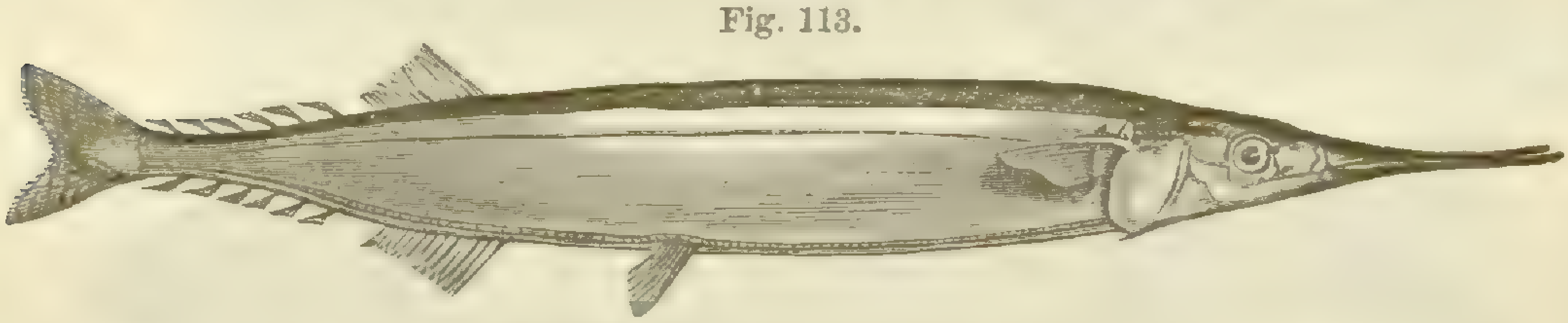
The Herring, *Clupea elongata.*

in their numbers. But there are some species of fish which visit our coast that are constantly diminishing in numbers, and our shores were formerly frequented by some fishes in great quantities, which have now nearly, if not quite, disappeared.

The Bluefish (*Temnodon saltator*), Fig. 111, which inhabits our waters from the last of June till September, has had very marked periodic variations in numbers. This fish, as history informs us, was captured and esteemed as an article of food by the earlier settlers of this state. Previous to the year 1763 bluefish were very plenty on the southern coast of Cape Cod, but about this year they all disappeared, and none were taken till sixty or seventy years after. For the

past thirty years specimens have been taken, but they did not arrive in any noticeable abundance till within the last sixteen years, and are at the present time again vanishing. During the last mentioned period I have observed them about Provincetown in great abundance, where they often presented a beautiful spectacle. At times the splashing of the water caused by these fish in their rapid motions in pursuit of their prey, could be seen as far as the eye can reach. They make great havoc among their weaker neighbors, and some fishes have been entirely driven from our waters by this ferocious species. All fish which are a prey to the bluefish migrate on its first appearance. In the case of the mackerel, fishermen have noticed that when a few bluefish have been caught during the mackerel season, that a few days after not

Fig. 113.



The Bill-fish, *Scomberesox Storerii.*

a mackerel could be found, having been driven from the vicinity by the bluefish. I think it may be affirmed that the disappearance of so many of our smaller fish is due to the destructive nature of the bluefish; it even drives fish much its superior in size.

In respect to our smaller fishes, the Herring (*Clupea elongata*), etc., we observe a considerable decrease in the numbers which now annually visit our shores, as compared with their former numbers. The Poggy (*Alosa Menhaden*) and the Herring (*Clupea elongata*), Fig. 112, have comparatively almost deserted the waters about Provincetown, where I have formerly seen them in immense schools very near the shore. Fishermen made nets and other necessary preparations every year to capture them on their arrival in the spring, and the business was carried on extensively and profitably for many years, but at the present time no such fishing there exists.

The Bill-fish (*Scomberesox Storerii*), Fig. 113, which but fifteen years since I saw stranded on the shore by the thousands, driven in by its devouring pursuers, has gradually decreased, till at the present time it has nearly, if not quite, been driven away, and I think that during the past year there was not one specimen seen at Provincetown.

CULTIVATION OF ALPINE FLOWERS.

BY ALFRED W. BENNETT.

Mr. Robinson is no mere enthusiast in his subject when he says:—"This book ('Alpine Flowers for English Gardens') is written to dispel a very general error that the exquisite flowers of alpine countries cannot be grown in gardens, and as one of a series of manuals having for their object the improvement of our out-door gardening, which it appears to me, is of infinitely greater importance than anything that can ever be accomplished in enclosed structures, even if glass sheds or glass palaces were within the reach of all." His first concern is with the structure of rockeries, in the mode of building which not only is the taste still displayed, or at all events till quite recently, barbarous and inartistic in the extreme; but it would seem as if the very conditions necessary for the health of the plants were studiously neglected. The ordinary idea of the treatment of rock-plants, judging from the hideous monstrosities which may be seen in many a gentleman's garden, is that you have nothing to do but to poke them in between the chinks of perfectly bare stones or clinkers piled together in a promiscuous heap, in order to present them in their native habitats. A gardener who commits such an absurdity as this, can never have ascended a mountain with his eyes open. To quote again from Mr. Robinson:—"Mountains are often bare, and cliffs are

usually devoid of soil; but we must not conclude therefrom that the choice jewellery of plant-life scattered over the ribs of the mountain, or the interstices of the crag, live upon little more than the mountain air and the melting snow! Where will you find such a depth of well-ground stony soil, and withal such perfect drainage, as on the ridges of *débris* flanking some great glacier, stained all over with tufts of crimson saxifrage? Can you gauge the depth of that narrow chink, from which peep tufts of the diminutive and beautiful *Androsace helvetica?* No; it has gathered the crumbling grit and scanty soil for ages and ages; and the roots enter so far that nothing the tourist carries with him can bring out enough of them to enable the plant to live elsewhere." Alpine plants are peculiarly exposed to sudden alternations of heat and cold, of moisture and dryness. The cold, almost frosty, night will be followed, in July and August, by an unclouded day, when the rays of the sun beat on the unsheltered surface of the rock with an intensity that would scorch up many an English meadow plant. Only a very small proportion of alpine plants are annuals; and they are frequently provided with a storehouse of nourishment in the form of rosettes or tufts of thick succulent leaves; but their chief water supply is through their roots; and thus we find that while our garden annuals have fibrous roots of insignificant dimensions, and even our forest trees will seldom strike their roots to a greater depth than the height of their foliage, the roots of alpine plants, scarcely an inch in height, will be found to penetrate the chinks between the rocks full of rich earth, to the depth of sometimes more than a yard, or forty times the height that they venture into the air. The neglect of this most essential condition for the growth of alpine plants is of itself amply sufficient to account for the failure which has generally accompanied the attempts to introduce these lovely flowers to our rockeries. A good depth of soil is indeed more indispensable to these plants than the presence of rock and stone. They no doubt prefer to expand their

flowers and extend their green shoots over the bare rock; and where rock-work is artistically managed, this faint attempt at a reconstruction of their native habitat adds greatly to the picturesqueness of the effect. But many of them will flourish equally well in open borders, and even when planted in pots, with a few stones about them to protect the roots from the direct action of the sun, if only the two requisites are attended to, of constant moisture and perfect drainage; and hence they are invaluable acquisitions to the cottage or window gardener. The Saxifrages, the beautiful purple *Aubrietia*, with respect to which Mr. Robinson says, "rock-works, ruins, stony places, sloping banks, and rootwork suit it perfectly; no plant is so easily established in such places, nor will any other alpine plant clothe them so quickly with the desired vegetation," the various species of Arabis, the alpine Primulas, all make excellent bedding plants. The ease with which a new alpine can be domesticated in our climate is shown by the rapid spread of the lovely early forget-me-not, *Myosotis dissitiflora*, brought not many years since from the Alps near the Vogelberg, now to be had from every nurseryman, and the treasure of many a cottage garden, with its exquisite sky-blue flowers, continuing from mid-winter till early summer.

But it is not alpine flowers only which will repay the small amount of trouble necessary for their introduction. Many plants which are never grown without the protection of a greenhouse, do not require any elevation of temperature for their successful growth, but merely an absence of great changes of both temperature and moisture. This is especially the case with not a few of the most delicate ferns, such as the elegant maidenhair, and the two fragile little filmy-ferns; and the requisite uniformity of temperature and moisture can be obtained out of doors by the erection of a partially underground grotto or ravine of rocks, through which water is perpetually trickling, the entrance being protected by a screen of foliage from the direct influence of the weather.

It is astonishing how equable a climate can be obtained by a simple device of this kind. The drawing given on p. 359 is from such a rock-cave constructed in the grounds of one of our most scientific and successful nurserymen near York, where he grows not only our royal so-called "flowering fern," the *Osmunda regalis*, and several foreign allied species, but the most beautiful of all this beautiful tribe, the moisture-loving Killarney fern, which clothes the soil of the damp dark woods by the Torc waterfall.

The beauty of these horticultural experiments is that they can be tried on so small a scale, and are thus within the reach of almost every one; yielding a source of pure and healthy enjoyment which few other pursuits will afford. Mr. Robinson almost promises us that his little book shall be the first of a series of similar manuals on different departments of gardening; and we can hardly conceive a greater service than this to a large number of his countrymen, who merely require to be told how to set to work to cultivate this fascinating science.—*Quarterly Journal of Science.*

WHAT IS THE "WASHINGTON EAGLE"?

BY J. A. ALLEN.

Editors of the AMERICAN NATURALIST: *Sirs:*—Will you please inform me through the NATURALIST or otherwise, whether you have ever known of the Washington Eagle (*Haliaëtus Washingtonii*), being captured or seen in New Hampshire. I have an eagle in my possession which I think is the "Washington Eagle." It was caught last spring in Goffstown, near Manchester, N. H. It is a large bird, measuring eight feet from tip to tip of wings, three and one-half feet in length, and weighs fourteen and one-half pounds. I have also two other eagles, a Golden, and a Bald Eagle. The Golden Eagle measures seven and one-half feet from tip to tip, three feet in length, and weighs twelve and one-half pounds. The Bald Eagle measures seven feet in extent of wings, and three feet from point of beak to end of tail, and weighs eleven pounds. I think that the Bald Eagle has a differently shaped beak from the other, and that is why I am in doubt

as to its species. Besides, I never knew of a Bald Eagle being so large. If you will please inform me in regard to the Washington Eagle you will oblige me very much. — WILLIAM JARVIS, *Hanover, N. H.*

THE "Washington Eagle" (*Haliaëtus Washingtonii* Aud.) appears to be still looked upon, especially by amateur ornithologists, as a probably valid, though little known species. The question of its true character was formerly a source of perplexity to professional naturalists, some of which may still regard it as having claims to recognition as a "good species." As our knowledge of the birds of this continent becomes more perfect, the existence as valid species of several of the hypothetical species, especially of the rapacious birds, becomes less and less probable. This results principally from two facts. First, through the constant accession of materials in our museums we are every year finding out more and more definitely the variations resulting from sex, age, individuality and locality to which each species is subject, and in these variations the forms which with greater or less probability gave rise to some of the doubtful species in our catalogues. Secondly, the continent itself and its fauna are becoming too well-known to render tenable the suppositions, formerly entertained, that some of the strange birds described in early times may have their habitats in unexplored districts, whence they have occasionally wandered to better known localities. The opinion long since advanced by some writers that the "Washington Eagle" is but a very large immature Bald Eagle, is hence gaining ground.

Audubon described his "Bird of Washington" from a large specimen taken by him in Kentucky more than fifty years ago. The original specimen from which Audubon made his drawing and description is not known to be extant, and seems to have never been preserved. Audubon appears to have been the only naturalist who examined it. He regarded it as a very rare bird, and states that he saw not "more than eight or nine" specimens. He does not seem, however, to have actually examined more than one. It dif-

fered, according to Audubon, in three important particulars from the common Bald or White-headed Eagle (*Haliaëtus leucocephalus*); namely, in size, habits, and in the scutellation of the tarsi. Its size (length, "three feet seven inches;" alar extent, "ten feet two inches;" folded wing, "thirty-two inches") greatly exceeds that of any known North American eagle, while it differed in habits from the Bald Eagle in being a true fishing eagle, and the scutellation of the tarsus, as represented in Audubon's plate, is a character quite unusual in any of the eagles. It is now well-known that the common White-headed Eagle will catch its own fish, instead of resorting to piracy for them, as is its usual habit. In respect to the scales of the tarsus, those in front are represented as being considerably larger than they are in the common eagle, but as this is one of the first figures Audubon published, it seems not unreasonable to suppose that they may not have been quite accurately drawn, and that his description of them was made from the plate instead of the specimen itself. It is difficult, however, to account for its great size, since the proportions of length of body and folded wing, to the alar extent are the same as in the common eagle, and hence leave little ground for the theory that through a typographical error the alar extent should read *seven* feet two inches instead of *ten* feet two inches, as has been suggested.

As already remarked, Audubon really obtained but a single specimen; and, as Mr. Cassin has observed, no specimen precisely corresponding to Mr. Audubon's bird having been obtained since its discovery, it has latterly, as Mr. Cassin adds, "been looked upon by naturalists, especially in Europe, as an unusually large specimen of the White-headed Eagle."* Numerous local observers have, however, reported it as occurring occasionally at different localities, and Mr. Cassin himself has doubtfully referred specimens to it taken in New Jersey. He even includes it as a good species

*Illustrations of the Birds of California, Texas, etc., p. 111, 1854.

in his "Synopsis of North American Birds,"* and in his report on the rapacious birds in Professor Baird's great work on the "Birds of North America." If not a valid species, of which there seems to be but slight evidence, it must be either an immature White-headed Eagle or an immature Northern Sea Eagle (*Haliaëtus albicilla*), since these are its only known near allies, though neither of these are known to ever quite equal it in size. The White-headed Eagle ranges in alar extent from a little less than seven feet to a little more than eight; and the Northern Sea Eagle is of about the same size. That it is not the latter is evident from the fact that Audubon describes his bird as breeding in Kentucky, a locality far south of the known range of the truly arctic Sea Eagle. It would be one of the strangest facts in natural history that a bird like Audubon's Washington Eagle should remain undiscovered for more than fifty years, when its alleged habitat is within the settled parts of the United States. On the whole it seems to me tolerably evident that this supposed species should be considered as based on a large example of *H. leucocephalus*, and that a "few grains of allowance" may be safely made for slight inaccuracies on the part of its enthusiastic discoverer. The bird referred to above by Mr. Jarvis I regard as unquestionably referable to the *H. leucocephalus*.†

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*Ibid.

† Farther remarks concerning the "Washington Eagle" may be found in the writer's "Catalogue of the Winter Birds of Florida," etc., in the "Bulletin of the Museum of Comparative Zoology," now in press, as well as concerning Bartram's mythical "Sacred Vulture," based on a singular combination of certain characters of the Caracara Eagle (*Polyborus tharus* Cassin), the White-headed Eagle (*Haliaëtus leucocephalus*), and the John Crow (*Sarcorhamphus papa*) of the West Indies. Reasons are there given also for referring the *Haliaëtus pelagicus* to the *H. albicilla*.

ACCLIMATIZATION OF FOREIGN TREES AND PLANTS.*

BY ALFRED W. BENNETT.

THE introduction of new forms of vegetable life into our gardens and greenhouses has made considerable progress during recent years. The Acclimatization Societies of Paris and London have, it is true, paid more attention to the domestication of foreign animals than of plants; something, however, has been attempted in this direction, and with considerable success. This branch of acclimatization would, indeed, seem likely to be the most fertile in results beneficial to mankind. For one fresh animal introduced that will be of real utility, there will probably be a dozen plants that yield important economical products. The early races of mankind appear to have exhausted our powers over the lower animals—the horse, the ass, the dog, the camel, the ox, the sheep, were all brought under subjection to man at the earliest period of his history; and within historic times no important addition has been made to the number of our domestic animals. Not so with plants. A large number of the vegetable substances used as food at the present day, and of the vegetable articles of manufacture, were unknown to the ancients; and the field for farther extension of our utilization of the vegetable kingdom seems indefinitely large. The power of cultivation in modifying plants is also much greater than any corresponding power of domestication in modifying animals. The oldest extant drawings of the horse, the ox, or the camel, scarcely point out any distinctive features from their descendants now living; the potato and the apple, on the other hand, may almost be considered as man-

*This article is introduced since it contains many hints of use to florists and gardeners in the middle states especially, where many subtropical plants can with care be made to grow.—EDITORS.

ufactured products; while many gardeners' flowers, such as the Pelargonium and the Tulip, differ so widely from their ancestors as, in some cases, to obscure their parentage. The term acclimatization has been objected to by some scientific men, on the ground that the descendants of any animal or plant which has been transported from one climate to another have no more power than their ancestor of adapting themselves to that climate, unless the principle of Natural Selection has come into play to eliminate the individuals least able to adapt themselves to the new climate, those only surviving which, from some cause or other, are most suited to the fresh conditions. Be this as it may, there is no question about the fact that the farmer and the gardener have it in their power to naturalize plants foreign to our climate and our soil.

But the conditions of this naturalization are by no means so simple as might at first sight appear. It might naturally be supposed that all we have to do is to introduce those plants which grow spontaneously in a climate and a soil similar to our own, and that they will necessarily flourish, and will scarcely be aware of the change. Or, if they come from a warmer country that all that is needed is to protect them by glass and artificial warmth from the inclemency of our winters. But in practice this is not found to be the case. A plant will frequently obstinately refuse to become naturalized in a country, the climatal and geological conditions of which are similar to those that occur in the region where it is indigenous. Our common daisy, a native of almost every country of Europe, is said to have resisted all attempts to introduce it even into the gardens of the United States. Some plants seem to have an unconquerable aversion to the fostering hand of man, even in their own country. A well-constructed and carefully kept fernery will contain specimens, more or less luxuriant, of nearly all our native ferns; the polypody and hartstongue from shady banks and tree-stumps; the so-called male and female ferns from the woods;

the spleenwort from dry walls; even the royal "flowering-fern" from bogs; and some of the semi-alpine species will flourish with the exercise of a little care. One kind, however, is almost invariably absent, and that the most widely distributed of all our ferns, the common break, a native of every county and almost of every parish in the country, but which can seldom be induced to remain a denizen of soil that has once been brought under man's dominion. On the other hand some of the greatest favorites of our gardens, which display no coyness whatever in overrunning our flower-beds, are natives of countries where the climate presents very different features to our own, or of very limited tracts of our own country, to which they seem strictly confined by impassable barriers of soil or meteorological conditions. To take instances of the latter phenomenon:—There is no garden flower more cosmopolitan in its tastes, more certain to thrive under any conditions of light or heavy soil, sun or shade, care or neglect, even in the heart of a town, as its very name seems to indicate, than the London Pride. Yet the *Saxifraga umbrosa* is one of the most restricted in distribution of our native plants. Abundant enough where it does grow, it is yet entirely confined to the moist equable climate of the hilly country in the south-west of Ireland and a few other similar localities, beyond which it is never found in the wild state. Botanists will think themselves amply repaid for a toilsome day's march by gathering the beautiful *Polemonium cæruleum* in its native habitat among the calcareous hills of the west of Yorkshire; yet the Jacob's Ladder is an ornament of every garden on the very stiffest part of the London clay. Probably every piece of cultivated ground, which contains a laburnum tree, produces each spring a plentiful crop of self-sown young trees, which come up without the least care or protection until destroyed in the process of weeding; yet the laburnum shows no disposition to take a place among the naturalized trees of our woods and hedges, although the seeds must often be carried there by

birds. It is remarkable that many of our common vegetables, the cabbage, the asparagus, the sea-kale, the celery, are natives of our own shores, never growing spontaneously out of reach of the salt spray; and yet requiring, when transplanted into our gardens, no peculiarity of soil or treatment to enable them to support a vigorous existence. These are instances of plants to which our climate appears entirely congenial, and yet which seem as if they could not propagate themselves with us or spread, except under man's protection. Others, again, appear to require only to get a footing in a foreign soil to become established in it with extraordinary rapidity, even to the overmastering or expulsion of some of the indigenous inhabitants. When Australia and New Zealand were first colonized by Europeans, their flora presented an aspect of perfect strangeness, very few of the native trees or flowers belonging even to genera common to Europe. The seeds of some of our English weeds were, however, introduced, intentionally or accidentally, by the early settlers; and now the thistle covers the waste lands of Australia as it does in England, and the clover and the groundsel everywhere remind the Englishman of his far-away home, and have become as completely at home as the mustangs or wild-horses on the pampas of South America. In our own country a very remarkable instance of this rapid naturalization has occurred in the case of the *Elodea Canadensis* or Canadian water-weed; which, introduced not many years since into our canals from Canada, has now become such a pest in many places as seriously to impede the navigation. Other instances might be mentioned of foreign plants introduced with seed having in a very short time become common weeds in all cultivated land. Indeed, many of the species included in our handbooks of British plants are so entirely confined to arable land or to spots in the immediate vicinity of human dwellings, that it is impossible to say how many of them may be really indigenous to the soil, and how many naturalized aliens.

There is no doubt we have a great deal to learn as to the mode in which plants propagate themselves in nature, which may be of the utmost value to our gardeners. Every one is familiar with the fact of the apparently spontaneous appearance in immense abundance, of plants in soil when subjected to certain farming operations, or on the sowing of some particular crop. Whenever a new railway cutting or embankment is made, some plant unknown in the neighborhood is almost sure to appear, and either permanently establish itself or again disappear after a few years. The "sowing" of land with lime is invariably followed by the appearance of a crop of white or Dutch clover. When certain kinds of wood are cut down it is said that during the next year a particular species of moss will always be found covering the ground. Immediately after the great fire of London in 1666, the London Rocket (*Sisymbrium Irio*) sprang up in enormous quantities on the dismantled walls, but is now no longer to be found in the metropolitan district. The usual theory to account for this sudden appearance of new plants is the existence in the soil of large "stores of seeds" ready to germinate on the first favorable opportunity. In his Anniversary Address to the Linnæan Society in 1869, Mr. Bentham, however, pointed out that if this explanation was the true one, it ought not to depend merely on theory, but would be capable of easy practical verification. He suggested whether a hitherto insufficiently acknowledged part in the rapid dissemination of plants may not be played by birds. The whole subject presents a wide field for farther investigation, and must amply reward any one who takes up the inquiry, if endowed with the qualities of accurate observation and patient research.

Mr. Mongredien's "Planter's Guide" deals chiefly with the introduction into this country of foreign trees and shrubs. Within the last twenty or thirty years the appearance of our lawns and plantations has been greatly changed by the number of new forms which have made their appearance. The

stately *Wellingtonia*, the formal self-asserting "Puzzle-monkey," or *Araucaria imbricata*, the massive Deodar and *Cryptomeria*, the elegant *Pinus insignis* and *Cupressus Lawsoniana*, are all still of too recent introduction to permit us to judge of what their effect will be when grown to their full stature. The number of cone-bearing trees from all parts of the world, perfectly hardy in this climate is extraordinary; and, partly from their graceful shape, partly from the evergreen character of their leaves, the attention of cultivators has been perhaps too exclusively confined to them, while deciduous trees have been comparatively neglected. Recent experiments have shown that in this quarter also there is abundant room for an extension of our powers of domestication. In one of the London Parks least frequented by the upper ten thousand, that at Battersea, great success has attended the introduction, during the last few years, of half-hardy trees and shrubs, the precaution being taken of protecting their roots during winter by a layer of some substance impervious to frost. The French have paid more attention to the perfect naturalization of half-hardy plants than we have done; notwithstanding the greater severity of their winter, species are grown by them out of doors which are never seen with us except in greenhouses; even as far north as Paris, the bamboo, for instance, is frequently met with in gentlemen's gardens; and there is no doubt that many shrubs and herbaceous plants, which we never think of attempting to grow except under protection, might, with a very little care and attention, become permanent denizens of our gardens and shrubberies. Probably few are aware that the common Camellia will stand with impunity an ordinary English winter. Mr. Mongredien says that "if protected during the first two or three years after being planted out, and when once established, it proves in the climate of London quite as hardy as the common laurel, and blooms as profusely as in a conservatory. It is true that, from its habit of flowering early in the spring, the blossoms are sometimes

damaged by the nipping easterly winds, but this occurs only in unfavorable seasons; and even if the tree never flowered at all, its lovely foliage would still make it one of the most beautiful evergreens of which our gardens can boast. A plant of the variety *Donkelarii* has stood out for twelve years in a garden at Forest Hill with a northern aspect, without the slightest protection during the severest winters, and now forms a good-sized bush, densely clothed with magnificent foliage. The Camellia ought to be planted out in every garden, and with a little attention for the first year or two, it would prove quite hardy, at least in the more southern counties, and each season it would increase in attractiveness."

The climate of the south of England is far more congenial to the introduction of foreign trees and shrubs than that of the northern counties, not from the greater severity of the winters in the north, for the minimum temperature of the year is often as low in Kent or Hampshire as in Yorkshire or Northumberland, but from the shorter and cooler summers. Many plants absolutely require a considerable period of high temperature to enable them to ripen their wood sufficiently to withstand the winter frosts, and especially to induce them to flower. In many parts of Scotland, however, the climate is as favorable to horticulturists as in any district in England. In the Duke of Sutherland's estate at Dunrobin, on the east coast of Sutherlandshire, Hydrangeas, myrtles, and other half-hardy plants, grow as freely and as unchecked out of doors as they do in Devonshire or Cornwall. The equalizing effect of the Gulf Stream on the temperature is no doubt the cause of this special immunity from frost. The proximity of the sea-coast is not generally favorable to the growth of trees and shrubs, not so much from the saltness of the air as from the prevalence of high winds, which are very injurious to growing vegetation. Young and tender shoots which will bear a moderate amount of cold, will sometimes be scorched as if by fire by a tempestuous night. — *The Quarterly Journal of Science.*

THE DISTRIBUTION OF THE MOOSE IN NEW ENGLAND.

BY J. A. ALLEN.

In consequence of their large size, the value of their flesh, and the pleasure attending their chase, the different members of the deer family (*Cervidæ*) are among the first to disappear before the progress of civilization in a newly settled country. The moose (*Alce malchis*), like the caribou (*Tarandus rangifer*), doubtless once existed in Southern New England, though I have seen no record of its occurrence in the south-eastern portions since the settlement there of Europeans. It probably remained in the mountainous districts till a later period, but for many years has been extinct in Massachusetts, Southern Vermont and New Hampshire, and Southern Maine.

In answer to my inquiries in respect to its present southern limit in Maine, Mr. J. G. Rich, the well-known hunter and trapper, writes me in substance as follows: "Although now scarce in that state, it is first met with on the Penobscot at about eighty miles above Bangor; on the Kennebec north of the Forks in Somersett county; at Kennebago Lake, and to the northward of Rangely Lake in Franklin county; and north of the Agiscohas Mountain on the Margalloway River, in Oxford county." A few also exist in the extreme northern parts of New Hampshire and Vermont. and in the Adirondacks of New York. As the experienced hunter finds it a not very difficult animal to capture, the moose unless protected by law, must soon become extinct throughout the New England States. The legislature of Maine has already passed a stringent game law for their protection, which it is to be hoped may be carefully enforced.

Mr. Rich's long experience as a trapper and hunter in the Maine woods, has rendered him thoroughly familiar with the

habits of the moose and the other large mammals of this region; and some years since (in 1860) he published an interesting series of articles in the now defunct "Bethel Courier," on the "Wild Animals of Maine," in which he brought together facts of great value to the naturalist, including the most complete history of the moose yet extant. It is to be hoped that he will be able to soon reissue these valuable sketches in a more permanent form.

NOTES ON CERTAIN INLAND BIRDS OF NEW JERSEY.

BY CHARLES C. ABBOTT, M.D

THE ornithological fauna of New Jersey having undergone some changes within the last few years, it may prove interesting to ornithologists to have the results of ten years constant, careful observation as to the movements of our inland birds; comprising those that are resident; those coming from the South in the spring, and visitors from the North in winter. Certain species formerly abundant are now rare; and others formerly but seldom met with, are now abundant. As an instance we will mention the Summer Red-bird (*Pyranga æstiva*), which may no longer be accounted a summer resident, although prior to 1857 it was abundant; and on the other hand the Snow-bunting (*Plectrophanes nivalis*), which previous to 1865, was a very rare visitor, and then only during very severe winters, and since has as regularly appeared as the *Junco hyemalis*. They do not appear, like them, early in October, but after considerable snow has fallen. During the winters of '67, '68 and '69, they were so abundant that hundreds of dozens killed on the outskirts of the town (Trenton, Mercer Co.), were offered for sale in our markets. Every additional snow storm seemed to in-

crease their numbers. They were very fat, and, considered as delicate as the Rice bird, *Dolichonyx orizivorus*, in October.

It may be proper here to state that the climate, during the past thirty-eight years, has undergone no change other than a slight diminution in the quantity of snow.

The species to which I desire to call particular attention are

1. Pigeon Hawk (*Hypotriorchis columbarius*). During the early autumn, when the Reed-birds (*Dolichonices*), have gathered in the marshy meadows, and the Red-winged Starlings (*Agelaii*), fairly blacken the drier lowlands; when the "Flicker" (*Colaptes*), is rattling off the thin bark from the hickories, and congregated Blue-birds twitter from every panel of fence; when the unsought Meadow-lark (*Sturnella*) challenges you to discover his retreat, with his saucy "you-can't see-me," and timid snipe (*Gallinago*), with a nervous "scape" endeavor to avoid the gunner's aim with a most eccentric flight,—then really are the days proper of our birds of prey, and all of our species, from the magnificent Black-hawk (*Archibuteo Sancti-Johannis*), to the saucy Sparrow-hawk (*Tinnunculus sparverius*), are more or less abundant. Ever on the alert for wounded birds or rash Meadow-mice, they sail over the meadows from morning till night and add no little charm to the attractive scene; but while all this is the order of the day upon the lowlands, there is skulking along the fences of the uplands, and about the yards of the farm-houses, a shy, cunning falcon, ever watching the farmer's poultry and pouncing thereupon continually. We refer to the Pigeon-hawk (*Hypotriorchis columbarius*), a species numerous throughout autumn and winter, but especially interesting from the fact that it remains throughout the year quite frequently.

In May, 1863, a nest of this species, with young birds just able to fly, was found by the writer in a large sycamore, on Duck Island, Delaware River, near Trenton, N. J. In

February (22d) 1865, a nest with eggs was also found by the writer, in a large elm, on the Shabbaconk Creek, near Lawrence, Mercer county, New Jersey. Young specimens in pin-feathers have been killed, in August and November, by a cousin of the author, which were seen and identified by the latter.

New Jersey seems to be a sort of neutral ground, as well as half-way house in the matter of geographical distribution. It is the northernmost limit of the range of some; the southernmost limit of the range of others; and occasional breeding ground of many species. From unascertained, and we imagine unascertainable causes, there are many visiting species that remain or pass on, as it may happen. An ornithological note-book will for one year record probably a dozen species, of which no trace will be found during the following year, except during their passage north or south. In 1859, a cold storm overtook the Red-starts (*Setophaga ruticilla*) as well as many of the warblers. During the following month (June) there were more nests of warblers about Mercer county than the writer has found in the ten summers since.

Since 1865, we have seen no Pigeon-hawks between the dates of March 15th and October 15th. They may have escaped our notice, but we opine not. Next summer Mercer county may have a dozen nests of this species.

2. Red-bellied Woodpecker (*Centurus Carolinensis*). This Woodpecker makes its appearance in April very regularly, and reappears in equal or greater numbers in October, and some few have been met with during the winter. It seems strange that it does not breed within state limits, but it certainly does not, except in a few isolated instances; at least this is the conclusion the writer has arrived at, as in accordance with his own observations. Correspondents in the extreme northern and southern sections of the state have written me, however, that they have found both them and their nests in May. These letters were from Sussex and Cape May counties. As it undeniably breeds in Pennsyl-

vania and in New York, it is probable that the reason of the author's failure in finding their nests, except in one instance (vide Geology of New Jersey, p. 765), arose from the fact that the natural features of the sections of the state he happened in were not such as attract the species. It, however, *does not breed, as uniformly within state limits, as the five other species of Picidæ common to the state.*

The cutting off of the heavier growths of timber, and general alteration, and rendering of the country's surface tame by cultivation, must have the effect either of changing the habits of the birds, or of driving them from their former haunts. The latter is generally the case, and undoubtedly is so with reference to this species. The other *Picidæ* are still abundant except two species, *Melanerpes erythrocephalus* and *Hylatomus pileatus.* Throughout the winter the "Sapsucker (*Picus villosus*), and Downy Woodpecker (*P. pubescens*), are very sociable, and appear as much at home in the maples along our town streets, as in the orchards beyond the village limits.

3. Traill's Flycatcher (*Empidonax Traillii*). The great influx of feathered life that comes to our state in the month of May is so varied as to species, and the many varieties having their particular haunts whereto they hie, that it is no easy matter, even after several attempts, to learn just what have come; and later in the season just how many have remained. That the list will vary year after year is unquestionable; but the species now under consideration is not one that simply remains during the summer occasionally. They do so now regularly, although their numbers vary very considerably. During the past seven summers the writer has regularly met with them. Previous to 1863 they are not mentioned in any of his note-books. They are, with us, a very restless, wild bird, remaining among the topmost branches of tall trees, and in such situations building their nests.

A nest of the Yellow-bellied Flycatcher (*E. flaviventris*),

was found at Princeton, New Jersey, during the past summer, containing young birds. This is the only nest of this species we have ever seen, but have met with the bird during the breeding season.

4. Wilson's Thrush (*Turdus fuscescens*). 5. Hermit Thrush (*Turdus Pallàsii*). 6. Olive-backed Thrush (*Turdus Swainsonii*).

Early in May, with the Chat (*Icteria viridis*), and House-wren (*Troglodytes ædon*), and spring birds generally, there appear in our gardens in town hopping close along the fence, upon the ground, modest little Thrushes, that at once attract the attention of the most careless observers by their general similarity to the grand Song-thrush (*Turdus mustelinus*), only *abridged*. With the same jerking of the tail, and a very similar chirp, they industriously overturn the dead leaves fallen the autumn previous, and gather from beneath them innumerable spiders, insects, and small worms. Every half hour this search for food is disturbed by a quarrelsome Wren, that is generally driven off when the Thrush becomes fairly angered, when it will resume its hunt for food. They at this time constantly chirp—never sing. These small Thrushes are referable to one, or all, as the case may be, of the three species we have named above.

Wilson's Thrush (*Turdus fuscescens*) is the less numerous of the three species previous to June 1st, and from then until October, is the most so. It breeds within state limits in greater numbers than do the "Olive-backed" or "Hermit," but is more retiring in its habits at this time of the year, and appears to wander very seldom any great distance from its nest, during incubation, and to remain in the neighborhood of the nest until those of its fellows and the allied species have begun to reappear from the north, when again they frequent town gardens as well as more retired "country" localities. This species at this writing (November 24th, 1869), is now in Trenton, New Jersey.

The Hermit-thrush (*Turdus Pallasii*) is said by Audubon

to be quite abundant in New Jersey during the summer (vide Birds of America, Vol. III, p. 30), but I cannot endorse this statement altogether; but there may have taken place a change since he wrote in the movements of this bird, especially as he gives the northern mountainous portions of Pennsylvania as the southernmost limit of the breeding locality of the *Turdus fuscescens*, which is now common to New Jersey. The "Hermit," as the writer has met with it, is about as one to eight in the numbers that breed here, comparing it with *Turdus fuscescens;* and as one to twenty, compared with the whole number of *Turdus Pallasii* that arrive here in May. They disappear from general observation about June 1st, and as Audubon has written "throwing itself into the depths of the forests, there spends the summer months, frequenting the lowest and most shady thickets." During the latter part of the month of August last, the writer heard one of these birds singing, for the first and only time. The song excelled that of *Turdus mustelinus*. Its usual note is a shrill chirp, not as frequently repeated as that of *Turdus fuscescens* or *Swainsonii*. They were last seen in Trenton, New Jersey, on the 20th of November.

The Olive-backed Thrush (*Turdus Swainsonii*) which was formerly more abundant than of late years, makes its appearance in May, with the two preceding species, and resembles them in all its habits. It is unquestionably the least abundant of the three, either as a migratory or resident bird. During the summer of 1866 (vide Geology of New Jersey, p. 768) the three species of Thrushes were unusually abundant; and during the summer, many Olive-backed Thrushes remained and bred. During the past ten years they have remained as compared with those of their numbers that went North, about as one to fifty. Certainly the proportion remaining is not less.

The habits of these Thrushes suggest the probability that changes in the climate must be taking place in the northernmost limit of their range, and to preserve an equal extent of

territory as breeding grounds, must come South in proportion as they are compelled to relinquish territory at the North. At all events, there is a steadily increasing list of those migratory birds that formerly never remained in New Jersey during the summer, and that now do so, raising one or more broods during their sojourn. To this statement the writer would add another, that the number of "isolated instances" of migratory species remaining, is also increasing. How many such "isolated instances" must occur to make the breeding of the bird within state limits a fixed fact? One nest a year or a dozen? Is it probable that the young birds raised in an "isolated instance" recognize their birth-place the ensuing spring and so remain? Thereby we would have as the result of an accident, a permanent habit established among that particular species. Would we not?

7. Ruby-crowned Kinglet (*Regulus calendula*). 8. Golden-crested Wren (*Regulus satrapus*).

In the Kinglets, of all other birds, it would be supposed that we had those that were strictly, so far as New Jersey is concerned, a northern-breeding, Jersey winter-sojourning species; and, indeed, the great bulk of them are so, except that they go farther South, of course, as well as remain here. Nevertheless, they too, break in upon long established rules and the records of the books, and have both been found breeding in Sussex county, New Jersey. At least, we have as evidence of this their presence in June, and also that of their young in August. Of those that spent the winter and left in the spring of 1869, there remained probably one per cent. The impression I may have given of their numbers during the summer, in the Geology of New Jersey, p. 769, is erroneous, in so far as one might suppose that they were common at that season. They are rare, but diligent search will generally discover two or three in the course of the summer.

The Kinglets do not seem to be much affected by the severity of the winter; except that during severe snow-

storms they seek the sheltered woods. In the depths of winter they and the Winter-wren (*Troglodytes hyemalis*), the Creeper (*Certhia Americana*), and the Black-capped Titmouse (*Parus atricapillus*), enliven the woods, especially a wooded hillside with a southern exposure. Such a position is the most favorable by far, for finding these and other small winter resident birds. Unlike the Winter-wren (*T. hyemalis*), the Kinglets are not quarrelsome, but quietly from limb to limb, and tree to tree, flit incessantly, gathering the dormant insect life beneath the bark. To recur to the subject of their summer sojourn is it fair to suppose that those that do remain are old and too feeble to perform the journey north? If so, would they not also be too old for nidification and incubation? We think so; and so cannot account for the specimens in pin-feathers.

At this date (November 24th), both species of Kinglet are very abundant about the trees in the streets, and are remarkably tame.

9. The Worm-eating Warbler (*Helmitherus vermivorus*). 10. Blue-winged Yellow-warbler (*Helminthophaga pinus*). 11. Golden-winged Warbler (*Helminthophaga chrysoptera*). 12. Yellow-rumped Warbler (*Dendroica coronata*). 13. Hooded Warbler (*Myiodioctes mitratus*).

We have now to take up the question of the geographical distribution of certain birds in a somewhat different manner, and to discuss, or rather to assert that we are not entitled to that usually or heretofore accredited to us. Of the five species of Warblers we have named above, four (except *Dendroica coronata*) have so far eluded us, although we have searched earnestly for them, after the spring visitors had gone. Coming as they did with them, and leaving simultaneously we supposed, like them, they, too, had gone north. This was our experience up to the time of completing our report for the "Geology of New Jersey." Three summers have since passed, and as yet we have found not even one specimen of the four species later than June 5th, and no

authentic nest. Of the many Warblers' nests we discovered there were four that we failed to identify, the birds belonging thereto not appearing when we had opportunities of watching. The general appearance of these nests which had eggs in was that of species common with us, although the eggs were a little peculiar. We have not had, since 1866, during any one summer, very good opportunities for hunting birds; but being ever on the lookout for the four species in question, we think it strange if they did remain throughout the breeding season without our detecting them.

As we have shown that some species that have heretofore always sought breeding grounds north of us now remain, therefore why should not others, formerly with us, conclude also to make a change, even though it be the opposite from that of their cousins? The surface of our state has materially changed in its general aspect within the past thirty years, since Audubon visited it; and these changes may have driven off certain species that probably are abundant no farther north or immaterially so, say Pennsylvania and New York. The changes we refer to are the very general cutting off of the woods, and clearing out of swamps. Certainly nine-tenths of the shelter that existed for birds in 1840 is now no longer in existence. The question may now be pertinently asked that if there is less shelter, why are there more new comers than there are departures of former residents? This we admit seems strange, and we can only answer it by asking another question; why should birds so similar as the *Sylvicolidæ* be of so many minds? Again, the four species in question are not at all sociable in their habits, and the new comers are; so we can see that the latter could be contented where the former would not, provided that the climate suited them.

The Yellow-rumped Warbler (*Dendroica coronata*), presents to us an instance of climatic geographical distribution which has not been published we believe; and that is, that from September to June this species has been met with in

New Jersey, on each of the intervening months. My attention was first drawn to it, by noting several in March, before any other species of the family had appeared. In February of the following year one specimen was seen and shot, and since then (1863), it has been met with sparsely in November, December, and January. These scattered Warblers are associated with the regular winter residents, Creepers, Nuthatches and Titmice.

14. Butcher Bird (*Collyrio borealis*). *We have seen the Shrike as early as September quite abundant*, but more generally it is in December and January that it is to be readily met with. No species visiting us from the North is more uncertain in its movements, and occasionally a winter passes without any being seen about. The snowy winters are those in which they are most numerous, and during such a winter their peculiarities are more readily studied, as they are during "open winters" far more shy and retired in their habits. With us they follow closely after loose companies of Snow-birds (*Junco hyemalis*), and seem to live very largely upon them. On the approach of warm weather they do not all go beyond the boundaries of the state, as the writer has seen them in Sussex county during the breeding season. *But very few individuals do remain however.*

15. Winter Wren (*Troglodytes hyemalis*). So like them in its appearance, and arriving in as large numbers so closely upon the disappearance of the *Troglodytes ædon*, there is a wide spread impression among persons with a smattering of disjointed ornithology, that they are one and the same bird, and that simply the former habit of migration has ceased. This absurd idea has gained ground in consequence of the very great accession to their numbers of the *T. hyemalis* that now annually appear. During the winter they are one of our most numerous species, ranking with *Passerella iliaca* and *Lophophanes bicolor* in this respect.

Like the "Shrike" (*Collyrio borealis*), they, too, do not depart wholly from us in the spring. Their numbers with

us in summer are much less than might be supposed, however, from my note in the "Geology of New Jersey," p. 776.

16. Red-bellied Nuthatch (*Sitta Canadensis*). A careful observer of the birds that now (November) are enlivening our generally leafless trees will not fail to notice continually a woodpecker-like moving little bird that has as unmusical a note as ever fell upon one's ear or added cacophonic variety to a harsh mixture, for verily the music of the woods hath now departed. Of the three birds to which these remarks are applicable, we refer particularly to that named above. A strictly northern species, early in November by ones and twos they make their appearance in company with *Sitta Carolinensis*, and to the casual observer they appear to be one and the same. In their habits, they, with us, present nothing distinctive. They number, we should judge, about one to twenty compared with "*Carolinensis*," and three or four per cent. remain during the summer. The locality of their nests and breeding habits are generally the same as in *S. Carolinensis.*

17. Black-throated Bunting (*Euspiza Americana*). Although abundant during the summer in Pennsylvania, less than one hundred miles from the state line (Delaware River), we had never, up to the end of the summer of 1867, been able to see these birds later than May, until they appeared in numbers in September. In the spring of 1868, and again during the past spring and summer, we found in various localities colonies of them breeding in low bushes, several nests being found in one field. We believe that for some reason we have not ascertained, they have annually left the state to breed and then reappeared. They are now with us (November) and we think that a few remain during the winter.

18. Rusty Black-bird (*Scolecophagus ferrugineus*). During the summers of '67, '68 and '69, these birds have been quite abundant about Trenton, New Jersey, associating with

the *Quiscalus versicolor* and *Agelaius phœniceus.* They built their nests invariably in trees growing upon the banks of streams, raising one brood only.

19. Snipe (*Gallinago Wilsonii*). We find on conversing with intelligent observers throughout the state, that in the immediate neighborhood of all those tracts of meadows where the Snipe first appear in March, or even earlier, that quite a number remain during the summer and breed. This has been our opinion and coincides with the results of our observations about the extensive tract of meadow extending along the Delaware River from Trenton to Bordentown, New Jersey. During the past few years we think the number remaining has increased steadily. In the autumn many arrive from the North and remain a longer or shorter time according to the weather. Indeed, so long as the ground is not too much frozen to enable them to feed, they are abundant; and after the formation of thick ice some still remain, resorting to spring-holes, and such open water as gives them a chance to thrust their bills in the mud; but we cannot imagine what they then find to eat. During the winter we have examined the stomachs of many, but the mass contained therein was invariably so far digested as to render it impossible to recognize anything, except that it appeared to be largely animal matter.

20. Tell-tale Sandpiper (*Gambetta melanoleuca*). 21. Yellow-legged Sandpiper (*Gambetta flavipes*).

Early in May, following the course of the Delaware River, these birds in company with other *Scolopacidæ* arrive in the neighborhood of Trenton, New Jersey, and on the muddy shores and marshy inland of Duck Island, and the extensive sand bars and grassy islands near and above the city mentioned, make themselves at home. By the first of June the great majority have gone North; but with the few smaller species that remain, and the myriads of *Tringoides macularius*, the "Tell-tale" and "Yellow-legs" now reduced in numbers, associate, and when feeding along the river act

as guides, apparently, and certainly as guards. Being at this time of the year very shy, they give notice of the approach of danger, and leading the flock, "Tell-tales," "Yellow-legs," "Solitaries" and "Teeter," fly in large circles, at a great height, and then resume their feeding near where they were previously to being flushed. During the breeding season, if frequently disturbed while feeding, they fly to their nests.

Both the "Tell-tale" and "Yellow-legs" have been found breeding in Mercer county, New Jersey. They seek some quiet nook along a small stream, and in the high grasses build quite a substantial nest, raising one brood that leaves the nest before being able to fly. At this time they are a dull mouse color, and when approached, squat so closely to the ground and remain so motionless, that it is nearly impossible to detect them.

22. Solitary Sandpiper (*Rhyacophilus solitarius*). Although the numbers remaining in New Jersey during the summer vary very much, we have never failed to find them during June and July, and August brings them again plentifully from the North. They breed as regularly in the state as the *Spizella socialis*, if not as abundantly. While the number of isolated specimens we meet with is large enough to warrant the descriptive name *solitarius*, yet many are seen associated with the other Sandpipers, especially in May and early autumn.

23. Mallard (*Anas boschas*). 24. Green-winged Teal (*Nettion Carolinensis*). 25. Blue-winged Teal (*Querquedula discors*). 26. Buffle-headed Duck (*Bucephala albeola*).

There is generally in April or May a freshet in the Delaware River, and one that usually overflows the tract of meadow mentioned when speaking of the Snipe (*Gallinago Wilsonii*). During the prevalence of this high water the ducks usually make their appearance in large numbers, feeding over the meadows in loose flocks, the species being the Mallard (*Anas boschas*), Black-duck (*Anas obscura*), Sprigtail (*Dafila acuta*), the two Teal (*Nettion Carolinensis* and

Querquedula discors), Shoveller (*Spatula clypeata*), Widgeon (*Mareca Americana*), Wood Duck (*Aix sponsa*), Whistler (*Bucephala Americana*), and Buffle-head (*Bucephala albeola*).

After the waters have subsided they generally congregate at the river, and after a week or more, during which time many are killed, they have left. But not wholly so, as during the summer months, besides the beautiful *Aix sponsa*, which we always have, there are quite a number of *Anas obscura* always to be met with, and not unfrequently the four species we have mentioned above. Of the four species the Mallard is the most abundant, and the "Buffle-head" least. That they all breed in the state there can be no question.

We conclude with the above, the selections from our notes, made in the field and at various times, on the peculiarities, if we may call them such, in the ornithology of New Jersey, with the thoughts they have suggested, believing they will be of interest to those especially giving attention to the subject of geographical distribution. Of the three hundred species of birds included in the ornithic fauna of New Jersey, of course there are many that are exceedingly rare in our territory. Among some species there have happened freaks of habit, unique instances so far as our experience goes, that though entertaining, are doubtfully of sufficient value to warrant their publication; but as apparently trivial occurrences have sometimes proved a help in the solution of difficult questions, we propose to give a plain narration of one or more such occurrences.

In January, 1869, an acquaintance in hunting over the Delaware (Trenton) meadows for hawks came to a lively spring in a hillside having a southern exposure. As he was about leaving it he flushed from grass still green and long, a pair of Virginia Rails (*Rallus Virginianus*), and fortunately killed them. They were both *fat*, showed no signs of having been previously wounded and thereby detained, and

flew as rapidly and with as much apparent vigor as in September. Farther search failed to discover others at the time. Two weeks later *three others were killed*, and in the first week of February, *one more*. These latter specimens were equally fat and vigorous. No similar circumstance has come under our notice.

Similar instances of the presence of the Night Heron (*Nyctiardea Gardenii*) have three times come under our notice. We have found these birds sitting on trees near springs, from whence the water flowed swiftly, and about which the grass remained quite fresh. Leaving them undisturbed, but watching them frequently, they were never seen to leave their perch. From the accumulation of droppings it was evident that the particular branch even, on which they were first seen, was that on which they had been resting for some time past. Only single specimens have been thus found, all male birds, and they have always been much emaciated. When forced to move they all proved able to fly, but returned to their accustomed place, after a circuitous flight of short duration. Were they too old to go South? Did they get any food? If so, what and where? On dissection the stomachs of these three specimens proved to be empty, but the *uppermost droppings were fresh!*

THE FORMER EXISTENCE OF LOCAL GLACIERS IN THE WHITE MOUNTAINS.*

BY PROFESSOR L. AGASSIZ.

Twenty-three years ago, when I first visited the White Mountains, in the summer of 1847, I noticed unmistakable evidences of the former existence of local glaciers. They

* Read, in the absence of Professor Agassiz, by J. B. Perry, before the American Association for the Advancement of Science, Troy meeting, Aug., 1870.

were the more clear and impressive to me because I was then fresh from my investigations of the glaciers in Switzerland. And yet, beyond the mere statement of the fact that such glaciers once existed here, I have never published a detailed account of my observations, for the simple reason that I could not then find any limit or any definite relation between the northern drift and the phenomena indicative of local White Mountain glaciers; nor have I ever been able since to revisit the region for more careful examination. This year a prolonged stay among these hills has enabled me to study this difficult problem more closely, and I am now prepared to show that the drift, so-called, has the same general characteristics on the northern and southern side of the White Mountains. Whatever, therefore, may have been the number of its higher peaks which at any given time, during the glacial period, rose above the great ice sheet which then covered the country, this mountain range offered no obstacle to the southward movement and progress of the northern ice fields. To the north of the White Mountains as well as to the south, the northern drift consists of a paste more or less clayey or sandy, containing abraded fragments of a great variety of rocks, so impacted into the minutely comminuted materials as to indicate neither stratification nor arrangement or sorting, determined by the form, size or weight of these fragments. Large boulders and pebbles of all sizes are found in it throughout its thickness, and these coarser materials have evidently been ground together with the clay and sand under great pressure, beneath heavy masses of ice; for they have all the characteristic marks so unmistakable now to those who are familiar with glacial action: scratches, grooves, furrows, etc. These marks are rectilinear, but they cross each other at various angles, thus showing by the change in their direction that the fragments on which they occur, though held for a time in one and the same position while these straight lines were engraved upon their surface, nevertheless changed that position more or less frequently.

A few flatter fragments with more angular outlines show only one kind of scratches, having evidently been held for a longer time in the same position. This drift, however it may vary in its mineralogical components in different localities, exhibits everywhere the same characteristic treatment over the whole country, from the shores of the Atlantic to the Rocky Mountains and beyond. In the White Mountain region it has the same mineralogical character north and south of the range, and rests everywhere upon the well known *roches moutonnées*, in one word, upon the planed, grooved, polished and scratched surfaces of the rocks underlying it.

Observation has taught us that materials such as those described above, so combined, exhibiting the same characters in their surfaces and having the same diversity of composition and absence of all sorting or regular arrangement, occur now at the bottom of the great glaciers of our time, and nowhere else; being found between the ice and the rocks over which it moves,—the result in fact of the grinding action of advancing glaciers. On account of their unvarying position I have called these deposits "ground moraines," because they are always resting upon the rocky floor of the country, between it and the under surface of the ice. Our typical unaltered so-called *northern* drift is synonymous with the ground moraines of the present day, differing only in its greater extension. It is in fact a ground moraine spreading over the greatest part of the continent. All its characteristics, identical in every detail with those of the deposits underlying the present glaciers, show that it can only have been formed under a moving body of ice, held between it and the underlying mass of rock. The great ice sheet of the glacial period which fashioned the drift must therefore have been co-extensive with the distribution of the latter. It is very important to distinguish this drift from the moraines formed under other circumstances, and from the so-called erratics and perched blocks. Moraines, as commonly understood, that is, lateral and frontal mo-

raines, consisting of loose materials collected along the sides and at the terminus of a glacier, always indicate, and, where undisturbed, actually define the margins of a moving mass of ice; whereas the so-called median moraines formed along the line of junction of the glaciers are carried upon the back or upper surface of the ice, and always consist of angular materials, the shape and arrangement of which are determined by their mode of accumulation. Just as among the glaciers of the present day we discriminate between ground moraines, lateral, frontal and median moraines, so must we also distinguish between the same phenomena in past times. The glacial period had also its ground moraines, its lateral, its frontal and its median moraines, its erratics and perched boulders. But the huge ground moraine of the earlier ice time stretched continuously, like the ice sheet under which it was formed, over the whole country—from the Arctics to the Southern States, and from the Atlantic to the Rocky Mountains. I do not speak of the western slope of the Continent, because I have not examined it personally. The great angular erratics of that period were scattered irregularly over the country, as the few large boulders are scattered on the upper surface of a glacier now. It is the contact of the more limited phenomena of the local glaciers which succeeded this all embracing winter (their lateral, frontal, median and limited ground moraines and their erratics), with the more wide-spread and general features of the drift that I have been able to trace in the White Mountains this summer. The limits of this paper will not allow me to do more than record the general facts, but I hope to give them hereafter more in detail and with fuller illustrations. The most difficult part of the investigation is the tracing of the erratics to their origin; it is far more intricate than the identification of the origin of ordinary drift, or of continuous moraines, because the solution of the problem can only be reached under favorable circumstances where boulders of the same kind of rock can be followed from distance to distance, to the ledge

in situ from which they were detached. Now, in the neighborhood of the White Mountains, we find beside the typical or northern drift, large erratic boulders as well as lateral, frontal and median moraines. A careful examination of these shows beyond a doubt that they came from the White Mountains and not from the northern regions, since they overlie the typical drift which they have only here and there removed and modified. A short description of the facts will leave no doubt upon this point.

The finest lateral moraines in these regions may be seen along the hillsides flanking the bed of the south branch of the Amonoosuck, north of the village of Franconia. The best median moraines are to the east of Picket Hill and Round Hill. These latter moraines were formed by the confluence of the glaciers which occupied the depression between Haystack and Mt. Lafayette, and that which descended from the northern face of Lafayette itself. These longitudinal moraines are particularly interesting as connecting the erratic boulders on the north side of the Franconia range with that mountain mass, and showing that they are not northern boulders transported southward, but boulders from a southern range transported northward. But by far the most significant facts showing the great extent of the local glaciers of the White Mountain range, as well as the most accessible and easily recognized, even by travellers not very familiar with glacial phenomena, are the terminal moraines to the north of Bethlehem village, between it and the northern bend of the Amonoosuck river. The lane starting from Bethlehem street, following the Cemetery for a short distance, and hence trending northward, cuts sixteen terminal moraines in a tract of about two miles. Some of these moraines are as distinct as any I know in Switzerland. They show unmistakably by their form that they were produced by the pressure of a glacier moving, from south, northward. This is indicated by their abrupt southward slope, facing, that is, toward the Franconia range, while their northern face has a

much gentler descent. The steeper slope of a moraine is always that resting against the glacier, while the outer side is comparatively little inclined. The form of these moraines, therefore, as well as their position, show that they have come down from the Franconia mountains. A few details concerning their location may not be out of place, in order that any visitor interested in the facts may readily find them without a guide. The ground to the north of Bethlehem slopes gently northward, and is not wooded for about half a mile from the street. Following the lane above mentioned, the first moraine reached skirts the edge of the wood and is near the houses of Mr. Phillips; there are four others more or less distinct before reaching a little trout brook called "Barrett's Brook." The lane descends more rapidly toward the brook than before, and where the descent begins to be steep the eye commands the space between the brook and a higher ground on which stands a house owned by Henry McCulloch. Over that interval six very fine moraines may be counted, one of which is perhaps the finest specimen of a terminal moraine I have ever seen. Beyond McCulloch's there are five more, not quite as distinct. The ground beyond the termination of the glacier of the Rhone in Switzerland is celebrated for its many distinct concentric terminal moraines; but here we have a field over which within the same area a larger number of such moraines may be seen, and I believe that a pilgrimage to this spot would convert many a sceptic to the true faith concerning the transportation of erratic boulders, especially if he has seen the glacier of the Rhone and can compare the phenomena of the two localities.

The Littleton road from Bethlehem, and the roads to Franconia Notch from both these towns frequently intersect terminal moraines. Those familiar with the topography of the Franconia range and its relation to Picket Hill and the slope of Bethlehem, will at once perceive that the glacier which deposited the front moraine to the north of Bethlehem village must have filled the valley of Franconia to and above

the level of the saddle of Picket Hill, making it at least fifteen hundred feet thick, if not more; thicker in short than any of the present glaciers of Switzerland. It will be observed, also, that as soon as the northern portion of that glacier had retreated to the wall which encircles the Franconia Valley on the north, the glacier occupying henceforth a more protected valley within the ranges, must have made a halt and accumulated at this point, that is, south and west of the saddle of Picket Hill, a very large terminal moraine. This moraine actually exists to the present day, and is one of the most characteristic features of the distribution of erratics in these regions. From the moment the glacier was reduced to the level of Franconia bottom it must suddenly have vanished entirely from the whole valley, and thus it happens that no other large terminal moraines are seen between that just mentioned and the higher range of Franconia.

Moraines similar to those observed on the northern side of the White Mountains exist also on their southern side in the vicinity of Centre Harbor. Lateral moraines may be traced at the foot of Red Hill, a little above Long Pond; also along Squam Lake. Median moraines are very distinct near Centre Harbor Hotel. Terminal moraines are also numerous near Centre Harbor and in the neighborhood of Meredith. At the southern end of Red Hill the lateral moraines trend westward and show their connection with the terminal moraines. These facts, taken in their relation with those enumerated above, show that there were local glaciers, on the southern as well as the northern slopes of the White Mountain ranges, moving in opposite directions; those on the northern slope moving northward, and those on the southern slope moving southward. I have seen no evidence thus far of these northern glaciers extending beyond the range of hills which separates the Amonoosuck River from the Connecticut River valley west of Lancaster, nor have I traced the southern glaciers beyond Lake Winnipesaukee. Traces

of an eastern glacier moving westward may be seen near the Twin Mountain House; but I have not examined that region with sufficient care to give minute particulars.

All these moraines and traces of local glaciers overlie the typical or northern drift so-called, wherever the latter has not been entirely swept away by the local glaciers themselves; thus showing that the great ice sheet was anterior to the local glaciers, and not formed by a spreading of smaller preëxisting glaciers. At least, wherever I have recognized traces of circumscribed glaciers in regions where they no longer exist, it has always appeared to me that the minor areas covered by ice were remnants of a waning sheet of greater extent. If the glacial period set in by the enlargement of limited glaciers already formed and gradually spreading more and more widely, as Lyell and the geologists of his school suppose, the facts which would justify such a view are still to be made known. I have not seen a trace of them anywhere. On the contrary, throughout the ranges of the Alps, in the Black Forest, the Vosges, as well as in the British Islands, in Scotland, Wales and Ireland, I have everywhere satisfied myself that the more extensive the glaciated areas, indicated by polished surfaces and moraines in any given locality, the older they are when compared with glacial phenomena circumscribed within narrower limits.

It therefore follows from the facts enumerated above, as well as from a general consideration of the subject, that the local glaciers of the White Mountains are of more recent date than the great ice sheet which fashioned the typical drift. On another occasion I hope to show that the action of the local glaciers of the White Mountains began to be circumscribed within the areas they covered, after the typical drift had, in consequence of the melting of the northern ice sheet, been laid bare in the Middle States, in Massachusetts and Connecticut, after even the southern portions of Vermont, New Hampshire and Maine had been freed, and when the White Mountains, the Adirondacks and the Ka-

tahdin range were the only ice clad peaks in this part of the continent.

When in their turn the glaciers of the White Mountain region began to melt away, the freshets occasioned by the sudden large accumulation of water remodelled many of these moraines and carried off the minute materials they contained, to deposit them lower down in the shape of river terraces. I have recently satisfied myself, by a careful examination, that all the river terraces of the Connecticut River valley and its tributaries, as well as those of the Merrimack and its tributaries, are deposits formed by the floods descending from the melting glaciers. What President Hitchcock has described as sea-beaches and ocean bottoms near the White Mountain and Franconia Notches, as well as in the Connecticut River valley and along the Merrimack, have all the same origin. The ocean never was in contact with these deposits, which nowhere contain any trace of marine organic remains.

NATURAL HISTORY MISCELLANY.

BOTANY.

Richardsonia scabra, a tropical American Rubiaceous weed, has every now and then been picked up and sent us from Georgia or Alabama; and if it is Pursh's *Spermacoce involucrata*, as is probable, it was introduced more than half a century ago. It appears that it is now taking wide possession of the soil in the piney region, and that it may play an useful part. Dr. F. J. B. Rœhmer, of Mobile, Alabama, writes of this plant as follows:

"This plant was comparatively rare here twenty years ago, but is now very common throughout the piney wood region of Alabama skirting the Gulf coast. It seems to choke out all the grasses by its more luxuriant growth. It is known by farmers, as "Mexican Clover," and may possibly have been introduced during the Mexican war, as it is said to grow in the rear of Vera Cruz. It is relished by all kind of stock, either green or cured.

In my capacity, during our late war, as botanist and chemist for the de-

partment of the Gulf, I introduced the roots of this plant into the supply table of the Confederate States Army, as an indigenous succedaneum for the true Ipecac, then exceedingly scarce, and as a substitute for the Euphorbias which had been recommended, but which were too violent in their operation, and I can say that in increased doses it answered every purpose."

Acclimatization of Palm Trees. — In addition to the date-palm and the *Chamærops*, which have long been naturalized on the European shores of the Mediterranean, M. Naudin has succeeded very well with several other kinds at Collioure, in the Pyrenees, notwithstanding the exceptionally unfavorable character of the winter of 1869–70. The severe cold of the last week of December, when the thermometer descended to — 4°, and in some localities even to — 6° C., was fatal to only one species. The extraordinarily heavy fall of snow which took place in January, lasting for forty-four hours without intermission, was expected to destroy the young trees altogether. After, however, they had been entirely covered up with snow for nine or ten days, so that the boughs were completely flattened, when the thaw came they almost immediately recovered their former position, even the green color of the leaves not being injured. The same fall of snow caused a fearful amount of destruction among the olives and cork-oaks. — *Quarterly Journal of Science.*

ZOOLOGY.

London Zoological Gardens. The whole number of animals in the Zoological Society's Gardens, usually somewhat exceeds 2000. On the first of January last, it was 2,031, consisting of 598 mammals, 1245 birds, and 170 reptiles and batrachians, besides the fishes in the aquarium, which do not appear to be included in the annual census. Constant additions are made to the series, not only by purchase, but also by gifts of correspondents in every part of the world, and by exchange with the continental establishments. — *Nature.*

The Nesting of the Fish Hawk. — Mr. Samuels in his "Birds of New England," speaking of the fish hawk, says "that seldom more than one nest is found in one locality" (in New England). At Harpswell, Maine, situated about twenty miles east of Portland, I know of at least fifteen nests of the fish hawk within one square mile. I think I might safely call the number twenty, but as I am writing I can only *distinctly* remember fifteen. A short time since speaking to a gentleman who has for many years lived at Harpswell, of what I had read in Mr. Samuel's book, he said, "tell him you know of a place where there are fifty nests within three miles, and I can find more places like it." These nests that I speak of were all on two small islands. These islands I visited exclusively, but I see no reason why there should not be nests on the rest also. On both of these islands the great blue heron and the night heron breed together

in quite large numbers. Mr. Samuels also says that they never molest their feathered neighbors. I have repeatedly seen the fish hawk attack the night heron and pursue it for a short distance. There seemed to be no reason for these attacks, but the hawk appeared to be venting his ill-humor upon the poor heron for want of some other object. Once when in a boat with two companions we saw a fish-hawk attack some water-fowl (the distance was too great to make out with certainty what it was), that was swimming by near its nest. The bird dove and the fish-hawk hovered about till it reappeared, when it renewed its attack. This performance lasted for a few minutes, and ended by the fish hawk's desisting from his assaults. — WALTER WOODMAN.

GEOLOGY.

GLACIERS IN PALÆOZOIC TIMES. — In "Notes on an ancient Boulder Clay of Natal," Dr. Sutherland describes an ancient "boulder clay," consolidated into a clay stone porphyry, "perhaps of Permian age," which rested generally upon old Silurian sandstones, the upper surface of which was often deeply grooved and striated. Mr. T. M'K. Hughes, while admitting the probability of a recurrence of glacial periods, disputed the evidence in this particular case. Prof. Ramsay "pointed out that in the Natal beds, under discussion, enormous blocks of rock occurred, which were sixty or eighty miles from their original home, and still remained angular: and there was a difficulty in accounting for the phenomena on any other hypothesis than that suggested. He still maintained the probability of the occurrence of glacial episodes, not only in the Permian, but in other ages, as he had done, now fifteen years ago." — *Proceedings of the Geological Society of London, reported in Nature.*

RECENT AND FOSSIL COPAL. — At the meeting of the Linnean Society held May 5th, Dr. J. D. Hooker read a communication from Dr. Kirk, Her Majesty's Vice-Consul at Zanzibar, on the distinction between the recent and fossil states of the resin known in commerce as Copal. One characteristic by which fossil copal is known from the recent resin is the so-called "goose-skin." Dr. Kirk has ascertained that the fossil copal shows no trace of this goose-skin when first dug out of the earth, but that it makes its appearance only after cleaning and brushing the outer surface. Both descriptions often contain imprisoned leaves, flowers, and insects in a beautiful state of preservation; but the fossil variety is clearer and more transparent. Captain Grant states that the true copal gum-tree is a climber reaching to a great height among the forest trees, finally becoming completely detached from its original root, when the copal exudes from the extremities of these detached roots. Large pieces of the resin fetch a very high price even in that country. — *Quarterly Journal of Science.*

AMERICAN ASSOCIATION.

NINETEENTH MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, HELD AT TROY, N. Y., AUGUST 17TH–24TH. 1870. [*Abstracts of papers continued from the October Number.*]

MR. W. H. DALL gave a short account of some researches into the structure of the Eskimo languages in which he was engaged. He showed how the radical words of the different dialects from Greenland to Bering Strait were essentially the same, while many of the adjectives, verbs and prepositional terminations differed in tribes which were closely adjacent. He then gave a description of the multiform changes of the termination of the verbs, showing that the Eskimo of Repulse Bay had, in the indicative mood of a transitive verb, five forms, only one of which (the present) had an exact equivalent in English. They were the present form or tense; the past imperfect, indicating an action just performed; the past perfect, indicating an action performed long ago; the future, relating to an action about to be performed; and the future perfect, which denoted an action to be performed in some future time.

The termination changing with the singular, dual and plural numbers, and the various cases of subject and object, result in a total number of seventy-eight affirmative terminations for the present tense, in a transitive verb, all different; the whole number of different terminations in the indicative mood is eleven hundred and ninety, and of the whole verb is over three thousand one hundred, including the affirmative, negative, and interrogative forms. The non-transitive verbs have a smaller number. The verbs "to be" and "to have" are identical and possess very few forms.

MR. DALL also gave an account of the anatomical characters of the conical univalve mollusks generally known as Limpets. These have been divided by Gray and other naturalists into two orders, according as the animal possessed one plume shaped gill over the back of the neck, or a cordon of lamellar gills all around the body. His recent investigation of the anatomy of many species, principally from the American coasts, had shown that the value of these distinctions was less than had been heretofore supposed. Some of the Limpets were shown to be entirely without special gills; others possessed a cervical plume-like gill, and also a cordon of accessory gills, greatly varying in extent in the different genera. For this reason he proposed to include them all in one order (named *Docoglossa* by Dr. Troschel) subdividing it into two sections characterized by the total absence, or by the presence, of gills. These suborders would respectively bear the names of *Abranchiata*, and *Proteo-branchiata*. The

Solenoconchæ and *Polyplacophora*, included by Troschel in this order, were to be eliminated; the former having the value of a subclass, while the latter form a well marked order. He concluded with some remarks on the synonymy of some of the genera most abundantly represented on our coasts.

Mr. THOMAS MEEHAN read a paper on "Nutrition and Sex in Plants." He referred to his "laws of sex," read last year, and now proposed to show that a decreased power of nutrition was one of the operating causes against that high state of vitality necessary to produce the female sex. He stated that there were two classes of male flowers on the common Chestnut (*Castanea Americana*), one from the axils of leaves on weak branches, the other terminating the vigorous shoots, only on which the female flowers are formed. The axillary male flowers mostly matured before the supra-pistillate ones opened. These were extremely weak, owing to the superior absorptive power of the females below them. He then exhibited some specimens of these, as well as some from a very large Chestnut tree, which had always borne abundant fruit, but had this year produced nothing but male flowers. The leaves were all striped with yellow and green, indicating, as every experienced gardener knows, that nutrition was obstructed. Plants over watered, by which the young feeding roots rotted, always put on this yellow cast. The yellow tint always followed "ringing" the branches, or any accident done to the bark. The influence of this *defective power of nutrition*, in this instance, he held so clear that he had no difficulty in concluding that it was *one of the agents which operated on the laws of vitality that governed the sexes.*

Prof. E. D. COPE of Philadelphia, read a paper on the "Reptilia of the Triassic Formation of the United States." He stated briefly the distribution of the rocks of Triassic age, and the localities at which vertebrate remains have been found. He stated that fourteen supposed species had been named, which had not been referred to their appropriate ordinal groups. He then pointed out that three of the genera, — Megadactylus of Hitchcock, Clepsysaurus of Lea, and Bathygnathus of Leidy, belonged to the order Dinosauria. This he had been unable to determine from the vertebræ, or even the limb bones, but from the pelvic elements. The structure of these in the first two genera was described and represented as a pair of coössified styles upon which the animal supported himself when in a sitting position. The fore limbs of the Megadactylus were rather long. The genus Clepsysaurus was, as Lea has pointed out, nearly related to Palæosaurus of the Bristol (England) conglomerate, while Bathygnathus was also related to the same and to Teratosaurus. Of the eleven species remaining, nine had been found by Prof. Cope to belong to the Thecodontia, and to be allied to the genus Belodon. He reduced the number of definable forms to four, stating that the remaining five were mostly established on the posterior teeth of the others. His fourth species he regarded as undescribed. It was the largest of the species, and was established on remains from Phœnixville, Penn., discovered by

Charles M. Wheatley. A portion of these was exhibited. They included bones of the extremities, pelvis, and vertebræ. The femora measured about thirteen inches in length. It was named *Belodon lepturus*.

The question of the greater or less generalization of types in the earlier ages was discussed, and evidence deduced from the Reptilia of the American Trias that such was the case. Thus there was much greater difficulty in distinguishing the Crocodiles and Dinosauria of the Trias, than those of the Cretaceous. This was to be especially seen in the forms of the vertebræ, and the femora. The Rhynchocephalia and Thecodontia were Triassic groups still more generalized and intercalated between the preceding and the later orders Lacertilia and Crocodilia. In the case of the former this was shown in the structure of the cranium and vertebræ; in the latter in the same regions, in the sacrum, in the extension of the rib-series to the latter, and in the limbs. The speaker explained that the structure of the quadrate region precluded the reference of the Triassic and Permian genera Parasaurus, Hyperodapedon, Telerpeton, Protorosaurus, etc., to the Lacertilia, as had been done by Huxley, but that they were truly Rhynchocephalia, an order represented by but one recent genus. He stated that he knew of no Lacertilian older than the Jurassic period.

Professor JAMES HALL read a paper "On the Relations of the Oneonta Sandstone and Montrose Sandstone of Vanuxem with the Hamilton and Chemung Groups." The object of this paper was mainly to correct some erroneous impressions regarding the geology of Eastern New York.

The sandstone referred to had been termed in the annual reports of Mr. Vanuxem the Montrose sandstone and Oneonta sandstone; the former a well marked locality in Pennsylvania; the latter in New York. This sandstone had been regarded as the terminal rock of the series, and as lying above the rocks of the Chemung group. The same views were entertained by Mr. Mather, who parallelized the sandstone of the upper part of the Catskill Mountains, with that of Montrose and Oneonta, giving a section from near the base to the top of the Catskill, without recognizing any important subdivisions.

In the final nomenclature the term Catskill group was adopted for the entire series. A red sandstone, which had been observed farther to the westward, along the Tioga River and upon the borders of New York and Pennsylvania, containing sales and bones of Holoptychius was regarded as part of the same group. Since this red sandstone of Tioga was known to thin out to the westward, it gave support to the hypothesis that it was only the thinning western extension of the formation which was so largely developed in the Catskill Mountains.

In the central and western parts of the State the limits of the Hamilton, Portage and Chemung groups, had been pretty well defined, the two latter occupying a great breadth in the southern counties. In the coloring of the map the great breadth given to the Catskill group in the eastern counties reduced the Chemung and Portage to a narrow belt giving an incon-

gruous aspect to the area, especially when we recognize the generally accepted view, that the source of the sediments has been to the eastward of these limits.

A few years after the close of the survey it was ascertained that in Delaware county, lying above the sandstones of Oneonta, there were several hundred feet of gray greenish and other sandstones and shales, containing the characteristic fossils of the Chemung group.

At the same time it was ascertained that the beds below the Oneonta sandstone in Schoharie and Otsego counties contained no characteristic Chemung fossils. The sediments it is true were found to be coarser than those of the Hamilton group in the central and western parts of the state, and contained the remains of land plants, but otherwise embracing the common characteristic species of that group. Waiting opportunities for farther investigation the results of these observations were not published, though the error has been partially corrected in the geological map published by the Geological Survey of Canada.

Later observations have served to verify the earlier conclusions, but there has been no opportunity of tracing out in a complete and satisfactory manner the limit of this sandstone formation.

An examination of the Hamilton group along the valley of the Schoharie creek, has shown that the more argillaceous deposits, with marine fossils, are succeeded by coarser beds with remains of land plants, and in the neighborhood of Gilboa numerous trunks of large tree-like plants have been found standing in the position in which they had grown. The entire thickness of the formation is not less than three thousand feet, and this is succeeded by the red and gray sandstone and shales originally described as the Oneonta and Montrose sandstones.

The entire thickness of this sandstone in Schoharie and Delaware counties has not been ascertained, but in the adjacent county of Otsego it is not less than five hundred feet, and is characterized by the diagonal lamination especially in the gray beds, and many of the layers contain remains of land plants.

The characteristic fossil Cypricardites * of Vanuxem is found in a shaly bed at the base of the sandstones in Richmond's quarry near Mt. Upton, immediately above a plant bed which, so far as at present determined, belongs to the upper part of the Hamilton group.

This sandstone so far as observed, rarely contains remains of fishes, and among them scales of Holoptychius, but all those seen had proved of distinct species from those of the Tioga red sandstone.

Lying to the south and above the sandstones we have the series of beds before referred to, containing the characteristic fossils of the Chemung group, and above this the sandstone and conglomerate of the top of the Catskill mountains.

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* The two species *C. Catskillensis* and *C. angusta* are both varieties of form due to pressure. The shell, however, is not a true Cyprycardites.

The parallelism of the groups in the eastern and western parts of the State may be thus presented: —

Old Red Sandstone of Tioga, etc	Catskill Mt. Sandstone,
Chemung Group,	Chemung Group,
Portage Group,	Oneonta Sandstone,
Hamilton Group,	Hamilton Group.

In the central part of the State there is no sandstone bearing the character of the Oneonta sandstone; on the contrary, the Hamilton group is succeeded by a series of shales, flagstones and heavy-bedded argillaceous sandstones constituting the Portage group. These two formations hold the same relative position to the Hamilton group below and the Chemung group above. The western extension of the Oneonta sandstone has not been traced beyond Chenango county, but it seems probable that we shall find a gradual diminution in the coarser material, a coming in of argillaceous matter, and the absence of the evidence of cross currents producing diagonal laminations, leaving the deposits of the same epoch to be spread out evenly over the ocean bed.

We are not yet quite prepared to assert that the Oneonta sandstone of Eastern New York is the precise equivalent of the Portage group. The former, being the deposits of stronger currents, may have preceded or followed the epoch of the slates and flagstones of the Portage as seen on the Genesee valley. It will be only after a careful examination of the Oneonta and Montrose sandstones that we can speak with certainty of its relations to the Portage, but we are prepared to show that it has no near relation in time to the red rocks of the summit of the Catskill Mountains, nor to the red sandstones with remains of Holoptychius, which occurs along the Tioga and upon the borders of Steuben and Alleghany counties of the State of New York.

Mr. J. B. Perry made a communication on "Boulder-trains in Berkshire county, Massachusetts." In Richmond, Berkshire county, Mass., there are six or seven nearly parallel trains of angular boulders, two of them particularly well defined. Attention was called to them years ago by Dr. Reid of Pittsfield. They have been also referred to, and in part described by Sir Charles Lyell, and the late President Hitchcock.

These trains originate partly in a range of hills consisting of chloritic slate, in Canaan, Columbia county, N. Y., but more especially in two other nearly parallel ranges of hills with a meridional trend near the State line in Richmond, Mass. The latter ranges consist of a greenish slate occasionally interstratified with beds of limestone. For the most part the boulders can be readily traced back to their exact source. Some of the trains may be followed south-easterly for four or five miles: others, passing over the Lenox range of hills, can be traced for ten or fifteen, and one of the larger for some twenty miles. Their direction during the first part of their course is south about 55° east. Somewhat farther on, they change their trend, it being some 35° east of south.

President Hitchcock presuming that there was a submergence of the

region, speaks of these lines of boulders as *osars*. Sir Charles Lyell also supposing a depression, thinks these boulders were transported by coast-ice.

There being no evidence of any considerable depression of this part of the continent during the Glacial Period, even if a submergence would afford an adequate explanation, which it does not, how are we to account for these boulder-trains?

As the vast ice-sheet which spread over the country gradually wasted, the elevations from which these boulders were derived would be at last laid bare. The ice no longer passing directly over the tops of the hills, there is evidence that the mass was parted, moving around the north-eastern and south-western sides of the several peaks. Of course, under these circumstances, the hillsides would be pressed and rubbed, blocks of slate and limestone detached from their places, and borne along upon the surface of the ice-sheet. This being at that time about six hundred feet in thickness, and continuing to thaw, the boulders would be carried forward for some distance, and finally left above the typical drift, as we now find them. As the ice wasted there would be changes in the direction of the moving mass, determined by the character of the underlying surface of solid rock, thus enabling us to account for the variation in the course of the boulder-trains.

Such, in brief, is the explanation suggested for these trains of angular rocks, and for some other similar phenomena in different parts of New England — an explanation in entire consonance with all the known facts connected with the glaciation of the country, and requiring no arbitrary resort to the theory of submergence.

Professor ORTON presented a paper "On the Evidence of a Glacial Epoch at the Equator," which controverted Professor Agassiz's theory of the glacial origin of the Amazon Valley. He briefly reviewed the statements made by Professor Agassiz that the Amazon formation did not contain a single marine fossil, and therefore was the product of an immense glacier that slid down from the Andes to the Atlantic. Professor Orton however, in his expedition across the continent, discovered an immense fossiliferous deposit at Pebas on the Maranon, and subsequent researches, carried on under his direction by Mr. Hauxwell, had resulted in the discovery of several other localities abounding in tertiary shells. A series of these were exhibited to the Association and excited considerable interest, not only from the novelty of their forms, but also from the fact that they were found in the heart of the great valley where Agassiz declared there were none. The shells are of fresh or brackish water types, and plainly indicate that the Valley of the Amazon, like the Pampas of La Plata as shown by Darwin, is an estuary creation, or the relic of a vast Mediterranean of fresh-water. In the minds of geologists present, these fossils settled the question of the origin of the valley; it was illogical and absurd to assume a glacial winter within the tropics when we do not dis over one solitary sign of its presence, —striæ and boulders are

not visible, and in their stead extinct shells are abundant. Professor Agassiz has declared that the Amazon clays are "drift" from the Andes transported by glaciers and ground down to an impalpable powder. But these fossils, some of them very delicate, are marvelously well preserved. Two explanations of the existence of these fossils have been given: (1) That they are accidental, being fragments of some formation elsewhere, mingled with the drift. But this hypothetical formation cannot be found. The valley is bordered by either palæozoic or cretaceous rocks. Besides, the fossils are *in situ* and identified with the peculiar Amazonian variegated clays. They must have lived and died in the vicinity of the spot where they are now found. (2) That the beds in which they are found may overlie the drift like the marine clay beds of Champlain. But the fossils are plainly of the same age as the formation in question, and cannot be later than the Pliocene. Moreover, the terraces which would result from submergence are not discernible within or on the borders of the valley.

Professor Orton then alluded to the glacial transmigration hypothesis, and showed by a comparison of the flora of the United States, and that of Andean highlands, that there had been no mingling of plants such as would have resulted had a vast glacier covered the whole or even the greater part of North America. And the conclusion reached was that facts were incompatible with the existence of an equatorial glacier and even of an intertropical cold epoch.*

Mr. R. W. RAYMOND, United States Commissioner of Mining, gave a description of certain typical physico-geological phenomena of the Pacific slope. The speaker, to save the time of the meeting, condensed into one rapid talk the substance of his two papers on "The Lava-ducts of Washington Territory," and "The Great Salt Marsh of Silver Peak, Southern Nevada." The former, he said, was a picture from the heart of the great volcanic overflows of the North, and the latter an equally characteristic scene from the region of solfataric and thermal-aqueous metamorphosis in the South. The accumulation of ice in the subterranean lava-ducts, the disappearance in them of streams ("lost rivers"), and various other features were briefly alluded to. The speaker ascribed the alkaline deposits of the Nevada basin to the decomposition of the soda-felspar abounding in the rocks, by means of hot gases and waters, and the subsequent percolation of these into the valleys.

Professor C. H. HITCHCOCK presented a paper upon "The Geology and Topography of the White Mountains." The topographical results were embodied in a model which he exhibited — a raised model on the scale of three-fourths of an inch to one thousand feet. This model is about four

* The fossils above referred were given to Mr. Conrad for identification. He distinguishes seventeen different species—all extinct, belonging to nine genera, of which only three are now represented. The species are *Isaea Ortoni*, *I. lintea*, *Liris laqueata*, *Ebora crassilabra*, *E. bella*, *Hemisinus sulcatus*, *Dyris gracilis*, *Neritina Ortoni*, *Bulimus linteus*, *Pachydon* (*Anisothyris*) *tenuis*, *P. carinatus*, *P. obliquus*, *P. erectus*, *P. cuneatus*, *P. ovatus*, *P. altus*, and a bivalve allied to *Mulleria*. Duplicates of these singular forms can be obtained of Professor Orton.

feet long, and shows the territory bounded by the Ellis, Saco and Peabody rivers. It is colored to show the distribution of the several formations. These are (1) several varieties of gneiss, called the White Mountain series; (2) granite; (3) eruptive granites and traps; (4) Staurolite and andalusite rocks belonging to the Coös group. The first group composed the main range of mountains in order from north to south, namely: Madison, Adams, Jefferson, Clay, Washington, Monroe, Franklin, Pleasant, Clinton, Jackson and Webster. Contrary to previously received opinions, it was said that the structure of this ridge is anticlinal and not synclinal, and the force crowding it up came from the north-west instead of south-east, as is the case everywhere else in the country. The relations of the granite to the schists is interesting. It is plain that the immense granitic area was eruptive, for at the boundary of the two enormous veins of granite had been injected into the schists. In the Saco Valley below the Notch, the granite occupies the lower area, and the schists upon the bordering ridges dip away from it in an anticlinal manner. The granite is the softest rock among the mountains, and therefore it is found chiefly in the valleys. These valleys have very abrupt sides, thus resembling the Yosemite valleys in California. The Professor could not agree with the theory of the California geologists, that the bottoms of these valleys had fallen out, he rather believed in the old-fashioned theory of denudation. The Coös group is a new one, it is not less than ten thousand feet in thickness, and is composed of a quartzite and limestone with staurolite slates and schists. It is characterized by the presence of silicates of alumina destitute of alkalies — and the minerals are staurolite, andalusite, and kyanite. Formations containing these minerals occur in New Hampshire, Vermont, Massachusetts, Canada, Nova Scotia and New Brunswick, and they were referred to this new group. The same had been described by Dr. Sterry Hunt a few weeks previous in the "American Journal of Science" as the Terranovan series, and some fossils of the Potsdam Period had been found in it in Nova Scotia. It would hence appear that this new system lies at the base of or below the Silurian, not far from the anciently supposed position of the *Taconic System*. That system had been the subject of violent discussion for twenty years, and he hoped that such results would not follow the proposal of the new *Coös Group.*

He next exhibited specimens of a new species of trilobite (*Acidaspis Whitfieldi*) from New Jersey, obtained from a boulder which was transported from New York by the glaciers. It came from the Marcellus slate. No other species of this genus had heretofore been found above the Schoharie grit.

Professor C. H. Hitchcock presented an argument to prove that a large portion of the North American Continent had been submerged beneath the ocean since the Drift Period. The proofs relied upon to maintain this position are the existence of twenty-seven species of maritime plants in the interior along the great lakes. These were specified by name and locality, extending up the Hudson River and Champlain valley and the

lakes of Ontario and Erie to Minnesota. He argued that these plants were originally introduced by natural emigration along an ancient estuary, and that many of them remain to the present day in consequence of the existence of conditions favorable to their preservation. He supposed that the plants about the salt springs in Northern New York were introduced in the same way. The pre-glacial flora has been completely destroyed by the intense cold, and while a new creation might explain the existence of salt water plants about the springs, it would not show why these marine plants could exist in the far interior. There should be a special fitness of species to conditions, in case the creation theory is invoked. He concluded that the continent must have been submerged two or three hundred feet lower than geologists had supposed, relying upon the ordinary arguments, and that the clays about Superior and Erie must have been of marine or estuary origin. It was quite unexpected that the present distribution of plants should throw so much light upon geological questions, and therefore it was urged that botanists should faithfully preserve the localities of all their specimens.

Professor T. Sterry Hunt said the presence of black iron sand upon many sea beaches has long been noticed both in Europe and America. Their origin is to be found in the crystalline rocks, from the disintegration of which these sands have been derived. The action of the waves, by virtue of the greater specific gravity of these sands, effects a process of concentration, so that considerable layers of nearly pure black sand are often found on shores exposed to wind and tide. These black sands vary in composition according to the localities, but as found on the coast of New England and the Gulf of St. Lawrence consist of magnetic oxyd of iron, with a large admixture of titaniferous iron ore, and more or less garnet, the purest specimens holding from thirty to fifty per cent. of magnetic grains. Such sands have long been employed as sources of iron in India, where they are directly converted in small furnaces into malleable iron. Early in the last century the considerable quantities of these sands found on our Atlantic coast attracted the attention of the colonists and of scientific men in England, and the Virginia sand-iron, as it was called, was the subject of many experiments. The first successful attempts at working it were, however, made in Killingworth, Conn., where the Rev. Jabez Elliot, grandson of the celebrated John Elliot, the apostle of the Indians, early turned his attention to the abundant black sands of the coast, and succeeded in treating them in a forge fire similar to the German forge or modern American bloomary fire. It appears from his account laid before the Royal Society of London in 1761, that he was then making iron blooms of fifty pounds weight from this ore, and that his son had already established a steel factory in Killingworth, when an act of the British Parliament forbade the manufacture of steel in the colonies. The London Society of Arts in 1761 awarded a medal to Mr. Elliot for his discovery. The working, however, was abandoned, and for a century no attempts were made in America to use these sands. Some four years

since the large quantities of them in the lower St. Lawrence attracted attention, and successful trials were made for their reduction in the bloomary fires of Northern New York, after which an establishment for working them was erected at Moisie in the Gulf of St. Lawrence, where, under the direction of skilled workmen from Lake Champlain, the treatment of these iron sands has been successfully carried on. These sand ores are remarkably free from both sulphur and phosphorus, and hence yield an iron of great purity and toughness. The working is effected in forges like those used on Lake Champlain, and presents no difficulties.

Prof. W. C. KERR remarked "On some points in the Stratigraphy and Surface Geology of North Carolina." The two long narrow belts (troughs) of coal-bearing triassic rocks in North Carolina, lying, nearly parallel, in a direction a little north of east, and separated by an elevated and rolling tract of metamorphic and granite rocks fifty to seventy-five miles wide, are found to constitute the fragmentary fringes of an eroded anticlinal, the one dipping north-west at an angle of 30° to 75°, the other south-east 10° to 35°. The material of this formation was furnished mainly by an ancient plateau or mountain chain lying eastward, between the mesozoic and the Atlantic, which "has left no sign" of its existence but this. I have found no trace of glacial action in North Carolina, even in the most elevated mountain plateaus, but abundance of Quaternary gravels, whose position is such as to negative the existence of glaciers in this latitude. Among these deposits occurs a remarkable peat bed, fifteen feet thick and about one hundred yards long, recently exposed in a railroad cut. Its position is very peculiar, at an elevation of more than one thousand feet above the sea, and near the top of a hill one hundred feet above the valley of the Catawba River (which is one mile distant), and twenty-five miles from the Blue Ridge. It is covered and protected by eight to ten feet of fluvial gravel and sand. It is peculiar also in its contents, being made up in considerable part of drift wood, and containing abundance of pine and hemlock cones (there being no hemlock forests nearer than the Blue Ridge) and other seeds, and also of charcoal, partially burned pine knots and charred logs.

Another peculiarity is that the peat, occupying the middle of the nearly vertical face of the cut (some eighty feet deep), and being exposed but one season, has put forth an abundant swamp vegetation, consisting of carex, juncus, and several species of swamp grass and weeds.

There are evidences in eastern North Carolina of considerable oscillations of sea level during the prehuman period (probably synchronous with the Champlain epoch). The accumulations of stratified gravels on the summits and slopes of the hills, at an elevation of more than three hundred feet above the present sea level, extending entirely across the State, at a distance of one hundred and twenty-five to one hundred and fifty miles from the coast, indicate the extent of this movement in one direction, while the minimum of elevation is indicated by the excavation of the channel of the Cape Fear River (e. g.) for more than thirty miles to a depth exceeding one hundred feet below the present tide level.

Professor W. C. Kerr on the "Probable Origin of the South Carolina Phosphates." The physical circumstances of the deposition of these beds in their present situation, have been explained in a manner sufficiently probable by Professor Pratt of Charleston; but I have seen no suggestion which is at all adequate to account for the origin of the materials which compose them, — the elimination and accumulation of such enormous quantities of phosphate of lime in so peculiar a situation.

The recent discovery of the singular Brachiopod, *Lingula pyramidata*, in the shoals along the sounds of North and South Carolina furnish a solution of the mystery. This shell, it will be remembered, consists of *phosphate* instead of *carbonate* of lime. Its habitat is at the precise level of the Ashley River phosphates, and the shell being very fragile and left within the play of the tides in the shifting sand of the shoals, rapidly loses its form and furnishes only its solid material, to be agglomerated by some concretionary or other chemical or chemico-mechanical force into the nodular masses which are so peculiar to this formation.

The Microscopical Subsection of the American Association for the Advancement of Science, which was initiated at the Salem meeting last year, was continued with renewed interest and increased numbers at the Troy meeting this summer, and promises to be a permanent and useful division of the Association. Under the Constitution, as amended this year, this department is removed from Section B (Natural History), and recognized as Subsection C of Section A (Mathematics and Physics). This arrangement, though somewhat confusing, is probably the most convenient that could have been made; microscopy proper, the science of the instrument, belonging strictly to mathematics and physics — but microscopy applied, the use of the instrument, being chiefly a department of Natural History. To avoid confusion at this point, authors of Natural History papers designed for this department should make a memorandum to that effect upon their MSS., as a request to the standing committee to assign them to Section A instead of Section B.

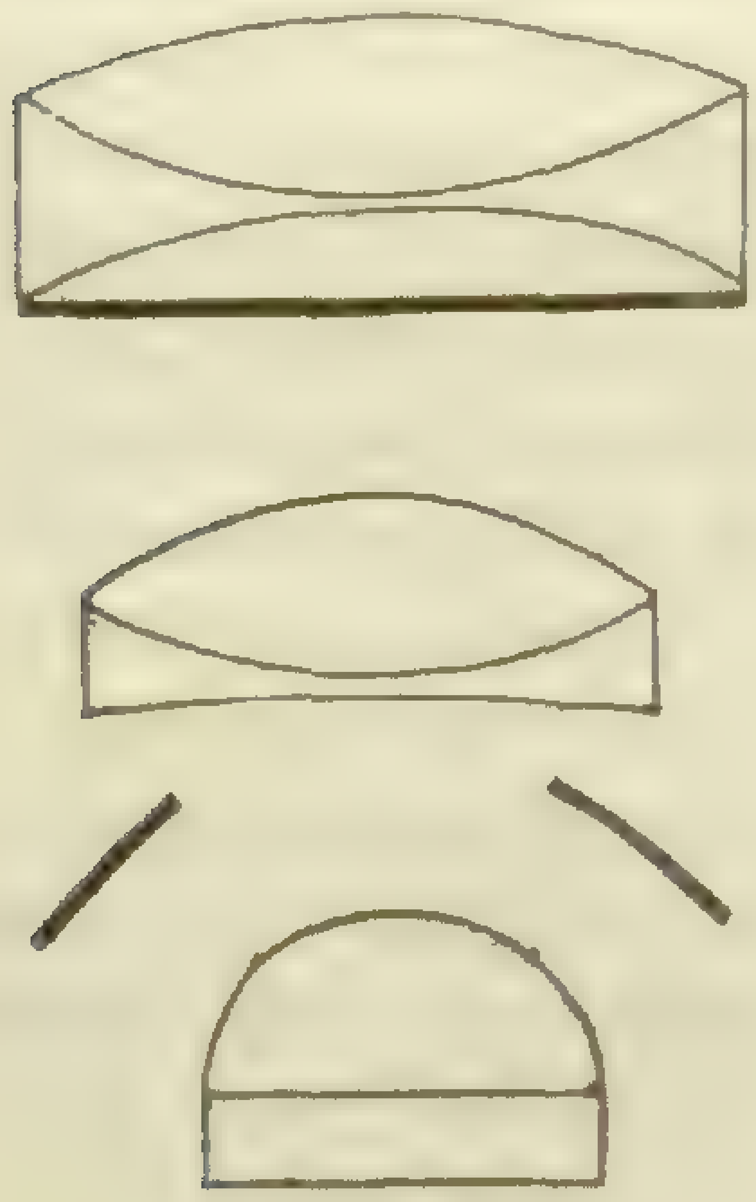
Professor S. S. Haldeman, of Columbia, Pennsylvania, was elected *Permanent Chairman* this year; and Dr. R. H. Ward, of Troy, N. Y., *Secretary*.

Although this subsection, having been recently formed, has necessarily been much occupied with the details of its own organization, it has already done much work and contributed some valuable papers, among which were the following, of which abstracts are published elsewhere: "On a new form of Binocular Microscope," by President F. A. P. Barnard, of Columbia College, N. Y., describing elaborately a newly contrived instrument in which the light is separated into two pencils by double refraction, and which cannot fail to be a valuable addition to the resources of the working microscopist; and "on the Illumination of Binocular Microscopes," by Dr. R. H. Ward, of Troy, suggesting convenient means of regulating illumination in the naturalist's every day work with the microscope, and urging that professional microscopists make their influence

more distinctly felt in regard to the lower classes of instruments that are furnished to beginners, and particularly in regard to popularizing the Binocular Microscope.

In exhibiting photographs by Dr. Maddox of the Podura scale, President Barnard gave an exhaustive review of the discussion in regard to the structure of the scale. The traditional "note of exclamation," or goose-quill markings are unlike those of any other known scale, and many naturalists are anxious, on grounds of analogy, to get rid of them. Mr. Beck argued that these marks represented parallel lines on different sides of the scale, crossing each other at an acute angle, and necessarily imperfectly focussed; some observers have attributed them to corrugations or folded ridges of the upper and lower membranes of the scale; and Mr. Pigott, with his aplanatic searcher, and others have seemed to resolve them into bead-like rows of spherules, between two membranes. The use of reflected light to determine these points is very desirable, but difficult with sufficiently high powers. Professor Smith, of Kenyon College, proposed to make the objective its own illuminator. Others have replaced the mirror he placed behind the lenses by a plate of glass or a prism; but all these means give a glare of light by reflection from the surfaces of the lenses. The speaker had proposed a concave mirror behind the outer pair, an internal Lieberkuhn (fig. 100) which works exceedingly well with medium powers, say one-third or one-fourth inch; but there is not room for its insertion in high powers. As compared with Tolles' prism, which is similarly situated (above the front pair), it gives more light, and illuminates from any part or all parts of the circumference at will; on the other hand it is less easily applied, requiring the front lens to be mounted in glass instead of brass, and it is inapplicable to large opaque objects. The beaded appearance has not yet been satisfactorily seen by reflected light; nor is it well shown in the photographs where the wedge-shaped dashes seem rather marked by crosslines or partial interruptions. The speaker evidently doubted the accuracy of the exclamation points, but was not yet ready to accept the beads. Appearances best seen by pushing an objective far beyond its ordinary power were received with general distrust.

Fig. 100.



In the discussion which followed the reading of this paper, Dr. Ward remarked that the production of a beaded appearance, as a purely optical effect, should be considered no longer doubtful, but rather an occasional accident to persons using high powers. As an extreme instance, in the case of a coarse and familiar structure, he related that while experimenting upon an elater of *Marchantia polymorpha*, that beautiful double spiral

was "resolved" into three rows of "beads" or "hemispheres," perfectly distinct and unmistakable, which occupied, of course, the position of the middle and edges of the spiral. They were illuminated by parallel light, very oblique, under a 1-15 objective of 175° worked at a power of 3,000 diameters.

Mr. E. Bicknell, of the Museum of Comparative Zoology at Cambridge, Mass., exhibited some diatoms recently thrown up by the sea at Marblehead, Mass. The deposit first found belonged to brackish water, as indicated by the nature of the diatoms and the presence of fruit of the *Characeæ*. The second deposit occurred about a mile from the first, and was purely of fresh-water origin; consisting of peat with fresh-water diatoms, — *Pinnularia*, *Stauroneis*, *Navicula rhomboides*, *N. serians*, etc. These deposits were thrown up by a severe storm on the 31st of March last, and are believed to be the first fresh-water or brackish deposits known to exist under the present ocean. They seem to be conclusive proof of the recent encroachments of the ocean upon the shore-line in that vicinity.

The Test Plate of Nobert, who has now "gone to the war," and Dr. Woodward's photographs of the same, were exhibited by Dr. Ward, chiefly in the interest of that part of the audience who were not professional microscopists, and might be unfamiliar with these wonderful works of human art. Until a year or two ago the finest lines had never been seen, even by the maker of them; now they have been seen by many persons, and have been photographed. He was now satisfied, for the first time, after hearing Mr. Bicknell's description, that the Boston microscopists had seen the *genuine* lines with powers of only five or six hundred diameters. In regard to the use of photography as a test of structure under high powers and difficult circumstances, we may learn a lesson from the broad bands of light and shade in the photograph of the coarser lines, which manifestly have no resemblance to the appearance of scratches on glass as seen under suitable powers.

Dr. Ward had also been investigating the effect of seeing two planes of the object at the same time with the Wenham's Binocular. The eye-pieces being practically not equidistant from the objective, the corresponding conjugate foci below do not coincide. Some microscopists have attributed much of the stereoscopic effect to this fact, which, however, does not seem to contribute perceptibly (except in the lowest powers, where the angular stereoscopic effect is necessarily very small, and where this difference of planes is most considerable), either to the stereoscopic effect, or to the increased distinctness of definition above and below the plane of most perfect vision.

An abundance of instruments were furnished by members to illustrate their discussions, or for the general work of the subsection. The first class stands were mostly of the make of Powell and Leland, and Beck, and Crouch, of London, of Nachèt of Paris, and of Zentmeyer in this country. The "Jackson" model of stand, with a curved arm, seems to be

growing in favor here; and it is to be hoped that those makers who have heretofore made only one style of stand will soon offer both; so that buyers can choose their style of stand irrespective of their choice of makers. In objectives and accessories Tolles, Wales, Zentmeyer, Grunow, Spencer, Miller, and some other American makers were represented; also Ross, Beck, Powell and Leland, Crouch, Collins, Murray and Heath, Swift and Browning, of London; Nachèt and Hartnack, of Paris; and Gundlach of Berlin. Very low power objectives, 3 and 4-inch, were deservedly popular. The use of immersion objectives for all high powers seemed to be assumed by all members as a settled question. Few members, on the other hand, fall into the present fashion of high power objectives,— preferring to use lenses of 1-15 or 1-16, and downward, and gain greater amplification by other means than by reducing the nominal focus of the objective.

Dr. Josiah Curtis exhibited a micro-telescope, or microscope and telescope combined, made to his order by Tolles. It is an ordinary Cutter's clinical microscope, fitted with an extra tube carrying an object glass of one inch linear aperture and six inch focus, to which objective the compound microscope acts as an erecting eye-piece. Furnished with a proper support this makes an admirable pocket telescope, defining well at powers of forty or fifty diameters.

Mr. Tolles had mounted a 2 1-2-inch lens with the society screw on each side of the shoulder, so that it can either be screwed on in the usual position, or passed up into the body of the instrument and fastened there, giving, by approaching the eye-piece, about the power of a 4-inch lens at the usual distance. Microscopists have been accustomed to gain a lower power than could be focussed by their rack, by screwing a low objective into the drawtube and focussing upon the object through the empty nosepiece. The new plan of a reversible mounting is more convenient, and is applicable to instruments that have no draw-tube; unfortunately it cannot be used with the ordinary Binoculars. The lens, though of second class, was very good.

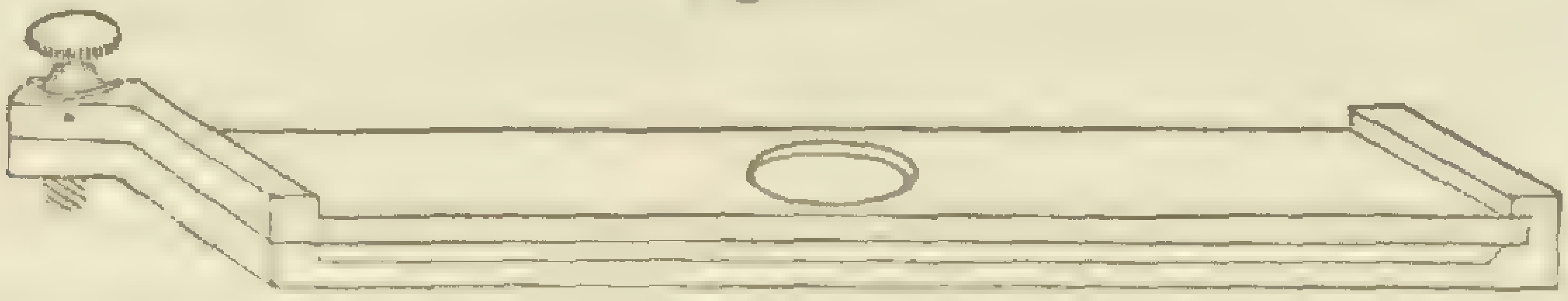
Mr. Tolles has also arranged a 4-inch objective in which a short working focus is obtained by a reducing lens in the rear. This reducing lens, for convenience, is mounted in a sliding tube, and gives when pushed in a fair 3-inch power. As a 4-inch the combination is extremely good.

Mr. Bicknell applies this expedient to ordinary objectives; placing in the draw-tube, instead of the concave amplifier sometimes used, an achromatic convex lens as a reducer, with which an extremely low power can be obtained with good definition, flat field, and working focus not inconveniently long. A 4 1-2 or 5-inch lens (solar focus) may be used. A low objective of two combinations may be divided, using one part as an objective, and placing the other in the draw-tube.

Dr. Ward had contrived a "clinical" compressor for use with the microscope of the same name. The clinical microscope is very convenient for examining mounted specimens, which is exactly what it is not wanted

for — except by teachers. He had used it for years in teaching, but not much as a "clinical" A glass slide to hold the object, with a thin cover held on by capillary attraction, is well for once, but does not satisfy a busy man. It applies to too limited a range of objects; and the cover is inconvenient to carry, awkward to handle, and easy to break. He had used Wenham's compressor until lately, but that is inconvenient under the springs of the "clinical" stage. The new compressor, figured below, is simple (and therefore inexpensive) and can be used with great facility both for clinical and class use, and for much of the ordinary work of the microscopist. It is reversible, except upon a large stage, in which case it would require a few pins to serve as legs. The want of parallelism is less than in most compressors, and is not inconvenient in clinical use. The two brass plates separate entirely for arranging the object or cleaning the glass. The upper plate fits into a notch filed in a ledge at the left of the lower, the centering of the two plates being secured by a pin through the lower and a notch in the upper. The screw which attaches them at the right is permanently fastened in the upper plate by a groove and a pin. It has a coarse thread, which may be cut double to screw out more rapidly, or the thread may be reversed near the centre so that it will at the same time raise the upper and depress the lower plate. Should a steadier motion be required, a spring may be riveted upon one plate to press against the other. The apparatus is adjusted for a glass of 1-20

Fig. 101.



Ward's Clinical Compressor.

inch below the object and 1-125 above, cemented upon the inner surface of the brass plates. This is strong enough to carry in the pocket safely; it can also be used with the parabolic illuminator, or with any objective or achromatic condenser except those of large angular aperture. Should thin glass be required for any purpose, a glass or tin cell of sufficient thickness to make up the difference should be cemented on one of the plates, or both if necessary, and the thin glass fastened upon the rim thus formed. Should no cell of suitable thickness be at hand, select a glass cover of the required thickness, fasten it with marine glue on one of the plates, punch out with a file the part corresponding to the opening in the plate, and then fasten the thin glass with Canada balsam upon this extemporized rim.

Mr. E. B. Benjamin, of New York, exhibited a microscope by Gundlach of Berlin. This was a small and cheap instrument, according to the English and American standard, but really admirable for its neatness of design and finish, and its general excellence of performance.

Beck's "popular" microscopes, binocular, were exhibited by Mr. C. E.

Hanaman and others. They have already vindicated their name in this country as well as at home.

Mr. Charles Stodder, of the Boston Optical Works, exhibited Cutter's clinical microscopes, and Tolles' students' microscopes, of various degrees of completeness and cost. These instruments are already too well known in this country to require comment. That they are thoroughly good of their kind is what is claimed for them, and is the least that can be said of them. In buying a students' microscope, however, the beginner should always be advised, in the writer's judgment, to have it furnished with a first class 1-inch objective or something very near it. So much of his early work is, or ought to be, done with this power, and his success as well as pleasure depends so much upon its light and definition, that it ought to be the last point economized upon. The sliding stage upon some of these instruments would seem to be easily convertible, for those who wish it, into a White's lever stage.

Mr. F. Miller, of New York, exhibited a good students' microscope of very low cost. It is chiefly notable for its large body, which admits a large eye-piece and gives a good field. Mr. Miller also exhibited excellent illuminating prisms and various accessories and objects, including Möller's beautiful type plates.

Crouch's educational microscope had a larger body than even Miller's, admitting the use of the same eye-pieces as the first class stands. The advantage of this is enormous in the case of the lowest eye-piece.

Blankley's neat and convenient tank microscope, made by Swift of London, was exhibited by Dr. Ward. Also Murray and Heath's "sea-side."

Of the general business of the subsection the most important was the appointment of a committee to report in relation to uniform standards in the power of objectives, eye-pieces, etc. President F. A. P. Barnard of New York, Mr. E. Bicknell of Cambridge, Mass., Dr. R. H. Ward of Troy, N. Y., Professor C. E. Pickering of Boston, Professor O. N. Rood of New York, and Dr. Josiah Curtis of Boston, constitute this committee.

ANSWERS TO CORRESPONDENTS.

J. J. H. G. — The Humming Bird you describe is the male of the common Ruby-throated Humming Bird (*Trochilus rubris* L.). The female and the young are without the brilliant scarlet color on the throat seen in the males. After midsummer the scarlet throated individuals are far less numerous thon the others. There is but one species of Humming Bird in the Northern States. — J. A. A

J. M. J., Halifax. — We will endeavor to name the collection of marine invertebrates for you.

S. A. W., Bucks Co., Pa. — Your fern is *Osmunda regalis*. — J. L. R.

S. L., Freehold, N. J. — The caterpiller is that of *Pieris rapæ* Shrank, which was introduced from England to Quebec in 1856 or 1857, and is stated to destroy annually $240,000 worth of cabbages in the neighborhood of that city. It thence spread into New England, and is now common about New York and Philadelphia. It feeds concealed on the heart of the cabbage, while the two other species of Pieris, *P. Protodice* and *P. oleracea*, feed on the outer leaves.

The other specimens were the pupæ of a species of Syrphus fly, which feeds on the plant lice, so abundant on the cabbage in the autumn. The Syrphus fly is of course very beneficial.

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THE FLORA OF THE PRAIRIES.

BY J. A. ALLEN.

PROBABLY the vegetation of no two adjoining regions, both of which are situated between the same parallels of latitude and at nearly the same height above the sea, presents greater differences than exist between the vegetation of the fertile prairies of the Mississippi Valley and the forest region that extends from their eastern border to the Atlantic coast. To one who has always lived amid the diversified scenery of the Eastern or Middle States, where distant mountains almost everywhere bound the view, and forest-crowned hills and cultivated valleys so agreeably alternate as to dispel the possibility of monotony, a first view of the primitive prairies,—

"The unshorn fields, boundless and beautiful,"

as Bryant has so felicitously described them, which

"stretch
In airy undulations far away
As if the ocean, in his gentlest swell,
Stood still, with all his rounded billows fixed
And motionless forever,"—

is extremely novel and full of interest. But the prairies, "unshorn" of their primitive wildness will soon be things of the past, so great are the attractions they hold forth to the emigrant, and so rapid the transformation that follows their

Entered according to Act of Congress, in the year 1870, by the PEABODY ACADEMY OF SCIENCE, in the Clerk's Office of the District Court of the District of Massachusetts.

settlement. Already there are few localities east of the Missouri where their primal simplicity and beauty have not already been more or less modified.

Great changes in the vegetation of a new country necessarily result from its settlement by an agricultural people, but the rapidity and ultimate completeness of the transformation greatly depend upon the relative susceptibility of the country to cultivation. Since vast areas of the prairies offer no obstructions to the revolutionizing plow, the astonishing rapidity of the change in the flora that follows its march can scarcely be conceived by those who have not witnessed its actual progress. No sooner is the sod inverted than scores of species of the original and most characteristic plants almost wholly disappear; in a few years the luxuriant wild grasses, overtopped with showy flowers, varying the hue of the landscape with the advancing season, have become supplanted by the cultivated grasses and the cereals, and that constant scourge of the agriculturist, the ever intrusive weeds. The timber no longer remains confined to narrow belts skirting the streams, for besides the newly-set orchards, rapidly growing kinds of trees, planted to afford shelter from the fierceness of the summer's sun and the fury of the bleak winter winds, everywhere diversify the landscape, while comfortable log cabins, or neatly painted, commodious houses give an air of civilization to districts that at no distant period were the undisturbed home of the buffalo and the elk.

Far more slow has been the change at the eastward, where the forests have slowly yielded to the axe of the woodman, and where much of the land is too uneven for cultivation. Here the forests, though in the longest settled districts perhaps once or twice removed, still cover no inconsiderable part of the country, and consist, for the most part, of the indigenous trees in nearly their original proportions, while the lesser shrubs and the herbaceous plants they primitively sheltered are still persistent, and to a great de-

gree occupy the neglected pastures, the roadsides and the waste nooks of the farms. In short the transformations of the flora of the prairies are often far more complete after a period of settlement covering but two decades, than are to be seen in those portions of New England which have been occupied by Europeans for as many centuries.

In the present article it is proposed to sketch briefly some of the peculiarities of the primitive flora of the Upper Mississippi prairies,* which not improperly, either in respect to their fertility under cultivation, or the luxuriance and beauty of their native vegetation, have been styled the "Garden of the West." The wild plants of the prairies present at every season features peculiarly attractive. In spring anemones and violets, as elsewhere, are among the early flowers, the latter of which are particularly numerous and characteristic, peering brightly out among the young fresh blades of grass. To these soon succeed several species of beautiful phloxes, the painted cup, and the prairie rose. Later still appear the purple and the white turban flowers (*Petalostemon violaceus* Michx., and *P. candidus* Michx.), the ceanothus, the hoary-leaved, purple-flowered lead plant (*Amorpha canescens* Nutt.), the purple cone flower (*Echinacea angustifolia* DC.), and, from its abundance perhaps the most conspicuous of all, the beautiful *Coreopsis palmata*, which here and there gives its own bright color to large patches of the undulating landscape. Blazing stars of several species (*Liatris squarrosa* Willd., *L. pycnostachya* Michx., *L. scariosa* Willd.), with their long nodding spikes of rose-purple flowers soon follow, ranking among the most showy of the many showy plants. To these are soon added sunflowers of various species, most common of which are the *Helianthus rigidus* Desf., the *H. giganteus* Linn., the *H. grosse-serratus* Mart., the *Actinomeris helianthoides* Nutt., and the *Lepachys pinnata* T. & G.; the tall compass plant (*Silphium lacini-*

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* The region more especially under consideration is Northern Illinois, and Central and Western Iowa.

atum Linn.); the Indian plantain (*Cacalia tuberosa* Nutt.), the tall verbena (*V. hastata* Linn.), and the yucca-leaved rattlesnake master (*Eryngium yuccæfolium* Michx.); all generally remarkable either for their large showy flowers, or the peculiar character of their foliage or habits. Finally the season closes with the later sunflowers and coreopses, some of which are of gigantic size, towering far above one's head; the purple-flowered gaurias and the golden epilobiums. From the first springing up of the early flowers till the frosts of autumn end the floral season, the prairies are arrayed in bright and showy hues by a succession of species of larger and taller growth, each later set not only overtopping their predecessors, but the rapidly growing prairie grasses. Ever varied too are the prevailing colors. Here blue prevails, there white or purple, and again large tracks are golden, as everywhere a few prevailing forms give character to the vegetation. Generally they are coarse, large plants, often resinous, with thick, harsh leaves and large flowers, and nearly all are species never or rarely met with in the Atlantic States, and never as characteristic species of the eastern flora. The *Compositæ* and the *Leguminosæ* are preëminently the prevailing families, far more so indeed than at the eastward.

Many of the species are in various ways remarkable, but none more so perhaps than the plant popularly known as the compass plant (*Silphium laciniatum*), whose large, thick, rigid, upright root-leaves, one to two and a half feet long, are reputed to uniformly present their edges north and south, whence its name. Though they do not thus *invariably* arrange themselves, they *generally* stand in this direction, so uniformly in fact that they well serve as a convenient guide to the traveller in determining the points of the compass.* Another species of the same genus, called the cup

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* Since the above was written an interesting paper on the Compass Plant was read by Dr. Thomas Hill at the Troy meeting of the American Association for the Advancement of Science, an abstract of which has just appeared in the NATURALIST (Vol. iv, p. 495, October, 1870). Dr. Hill refers this polarity to the sunlight, the two sides of the leaf being equally sensitive, and struggling for equal shares.

plant (*S. perfoliatum*), from the large opposite leaves of the stem being connate at their bases, forming a considerable cup-like cavity, capable of containing water, is common in the moist ravines. Other remarkable forms are the Indian plantain (*Cacalia tuberosa*), conspicuous for its thick, smooth, plantain-like leaves, deep-green on both sides and strongly ribbed; and the yucca-leaved rattlesnake master, or button snakeroot (*Eryngium yuccæfolium*), with its linear grass-like, bristly fringed leaves, and its bracted flowers, closely sessile in dense heads,—an umbelliferous plant, but wholly unlike the generality of the species of the *Umbelliferæ*, both in its foliage and in the form of its inflorescence. The prairie clovers, or turban flowers (*Pentalostemon*), are among the most interesting of the leguminose species, and among the most characteristic. Their oblong or cylindrical heads of white or purple flowers are evidently suggestive of the latter name. Each head continues in flower for many days. At first the flowers form a band at the base of the head, which, gradually moving upward, later occupies the middle of the head, and finally its summit, recalling the Oriental head-dress, in allusion to which these plants have received one of their common names.

The habits of some of the sunflowers, but especially those of the *Helianthus rigidus*, present one feature of interest. The *H. rigidus* is one of the earliest flowering species and one of the most abundant ones, it being in some localities one of the most conspicuous and characteristic plants. By the middle of August it has attained nearly its full height, which commonly ranges from two and a half to four feet; the terminal heads of the earlier specimens have already begun to unfold their yellow rays, and those of the rest are nodding on their flexible stalks. It is a popular belief that the sunflower always turns its flowers towards the sun, but in reality so numerous are the exceptions to this rule in our garden sunflowers and in our common wild species of the East, that few observing people regard it doubtless as other-

wise than an idle whim. With many of the prairie sunflowers, however, the facts are different; especially is this so in the case of *H. rigidus.* Morning after morning, at flowering time, the heads of this species may be seen bending gently towards the east; they are erect at mid-day, and at evening gracefully droop towards the west. This continues day after day for weeks, with surprising regularity and uniformity. Later, however, the stems grow rigid and remain nearly vertical. In this case at least the popular notion referred to above seems well founded.

Aside from the open prairie species already mentioned—which embrace the greater part of the most conspicuous ones—numerous others of almost equal interest are found growing in the low grounds, and in the open forest belts that skirt the streams. Prominent among these are coreopses and sunflowers of several species, especially the *C. aristosa* and *C. tripteris*, *Helianthus strumosus*, *H. decapetalus* and *H. tracheliifolius;* the ground nut (*Apios tuberosa* Mœnch.) with its fragrant, dark purple flowers; the western iron weed (*Vernonia fasciculata* Michx.), the great St. John's-wort (*Hypericum pyramidatum* Ait.), the broad-leaved polygonum (*P. Pensylvanicum* Linn.), and, in more open and drier places, the rag-weeds (*Ambrosia*), the wormwoods (*Artemisia*), the tick-trefoils (*Desmodium*), the bush clovers (*Lespedeza*), and the psoraleas. Many species of such eastern plants as love rich moist woods, are also found here.

One of the strangest features, perhaps, in the flora of the prairies, and that which of course constitutes them prairies, is the entire absence of arboreal or even suffruticose species, the timber of this region, as is well known, forming open park-like belts along the streams, which with great propriety have received the name of "groves." Here the species, as might be expected, more strongly recall the flora of the East, the resemblance extending not only to the trees and shrubs, but to the herbaceous species that flourish beneath their shelter. But the predominant species can hardly be regarded

as properly eastern forms, while the entire absence of representatives of some large groups of trees and shrubs that are common at the East makes the difference greater than at first seems. One may traverse hundreds of square miles in the prairie districts without meeting a single birch, alder, a chestnut, beech, or aspen (*Populus tremuloides* Michx.), nor any species of pine, spruce, hemlock or other coniferous tree, all of which are so abundant in the forests of the Atlantic States as to constitute the prevailing species. Two species of cottonwood (*Populus monilifera* Ait., and *P. angulata* Ait.), so closely allied as to be confounded as one by the casual observer, but neither of them exclusively western, are probably the most characteristic trees, as they are certainly the most abundan't and important. The sugar maple, the linden, elms, bitter-nut and other hickories (chiefly the former), butternuts, black walnuts, burr, white, black and other oaks, several species of ashes, the beautiful ash-leaved maple (*Negundo aceroides* Mœnch.) and the locust (*Robinia Pseudacacia* Linn.), are the principal and almost the only important kinds of timber, the greater number of which are more or less common trees. Among the shrubs are several species of sumach (*Rhus*) and the hazel bush (*Corylus Americana* Walt.), which here, as at the East, principally compose the thickets, whilst the *Ceanothus*, or Jersey tea, is a frequent inhabitant of the prairies. One searches in vain, however, for any whortle-berry bushes (*Vaccinium*), of which so many species abound at the East, or for any representatives of the large family *Ericaceæ*, than which no family is more characteristic of the woodlands of the Eastern States. Viburnums are common, and the elder (*Sambucus Canadensis* Linn.), the honeysuckle (*Lonicera*), the snowberry (*Symphoricarpus*), and other caprifoliaceous shrubs are more or less frequent. The wild apple, the Washington thorn (*Cratægus cordata* Ait.), and the wild plum are common among the rosaceous shrubs, but blackberries and raspberries are rare. The wild plum grows in the river

bottoms in unsurpassed perfection. Though they are all, or nearly all, of the same species (*Prunus Americana* Marsh), the varieties in respect to the form, size, color and quality of the fruit are almost endless, the plums varying in form from spherical to egg-shaped, and from nearly white through every intermediate stage of color to yellow and even dark red, and in flavor from bitter, uneatable kinds to those as delicious as the highly cultivated varieties of the garden.

From the abundance of woody climbers the forests of the river bottoms sometimes present an almost tropical aspect. The Virginia creeper (*Ampelopsis quinquefolia* Michx.), and the winter grape (*Vitis cordifolia* Michx.), climb to the tops of the highest trees, with a diameter of the stem exceeding any specimens I have elsewhere seen. Other climbers are frequent, including the singular wild cucumber, or balsam apple (*Echinocystis lobata* T. & G.), which assumes an almost tropical luxuriance, here and there abundantly enveloping the trees.

The restriction of the forests to the river bottoms and their banks has previously been alluded to as a remarkable feature, of which various explanations have been offered. The fact of the rapid encroachment of the forests upon the prairies wherever they have been protected from exposure to the annual fires that formerly swept over the country, and the rapid growth of the timber whenever it becomes established, indicate clearly that not only have the fires had much to do with their restriction, but that there is nothing either in the climate or the soil unfavorable to their rapid spread. The damper northern slopes of the streams being also generally better wooded than the necessarily drier southern slopes, also points to the fires as the great agency that has operated through long ages to check their increase, and that their circumscription has had little to do with the peculiar origin of the prairies and of their present flora, as some have formerly supposed.

As has been already incidentally remarked, the vegetation

of the open prairies, as compared with the herbaceous vegetation of regions to the eastward similarly situated geographically, is mostly made up of coarse, large species, and of forms peculiar to the prairies. It consists, moreover, principally of a comparatively few predominant forms,—features strongly in contrast with those of the neighboring regions. The grasses, like the exogenous species, are also few in species, but coarse and luxuriant, as they are the product of a soil of unsurpassed fertility. Yet the flora as a whole is one singularly susceptible to the inroads of civilization. Even the grazing of cattle for a few years is sufficient to materially alter its character. The grasses, according to the testimony of early settlers, soon dwindle in size and luxuriance, while the relative abundance of the other plants becomes materially altered. As already remarked, the breaking and turning of the soil at once exterminates a large number of the previously dominant species, and instead of lingering as troublesome weeds, the more hardy exotics, that through man's influence assume an almost cosmopolitan habitat, usurp their places, the cereals, the cultivated grasses and the noxious weeds of the old world thoroughly crowding out the original occupants of the soil. With all the beauty and the novelty of the primal flora of the prairies, the traveller, after a few weeks of constant wandering amid their wilds, is apt soon to experience a monotony that becomes wearisome, the full degree of which he scarcely realizes till the soft green sward and the varied vegetation of cultivated districts again meet his eye.

DISTRIBUTION OF THE MARINE SHELLS OF FLORIDA.*

BY DR. WILLIAM STIMPSON.

One of the most striking peculiarities of the zoology of Florida is the diversity in the character of the littoral shells of the two sides of the peninsula. The naturalist passing from St. Augustine to Cedar Keys finds upon the western beach a group of shells so different from those he had seen upon the Atlantic shore, that he is reminded of the similar (though vastly greater) difference in the fauna which exists on the two sides of the continent itself; for instance, at the isthmus of Panama. This diversity is seen in the common large shells as well as in the fauna taken as a whole. Thus on the east coast *Busycon canaliculatum*, *B. carica*, *Dosinia discus*, *Arca incongrua* and *A. Americana* are the most abundant shells, while they are not found at all on the west coast; and at Cedar Keys and Tampa Bay we find the subtropical species *Cassidulus corona*, *Busycon perversum*, *Pyrula papyratia*, *Strombus alatus*, *Bulla occidentalis*, *Callista gigantea*, *Dosinia elegans* and *Arca Floridana?* strewed on the beaches in great numbers, while they occur but rarely on the east coast; some of them not at all. The list presented contains the names of three hundred and fourteen species collected by me on the two coasts, of which only one hundred and forty-five, or less than half, were common to both; fifty-eight being peculiar to the east and one hundred and eleven to the west coast. Several of these species are indeed representative, but specifically quite distinct. These results will no doubt be considerably modified by future researches, as some of the smaller species may have escaped detection on one or the other of the two shores, although really existing upon both. But the fact will, nevertheless, remain that a marked difference exists between the faunæ of these shores notwithstanding their proximity and notwith-

* Abstract of a paper read at a recent meeting of the Chicago Academy of Sciences.

standing the comparatively recent origin of the peninsula which separates them.

Of the recent origin of the Floridan peninsula (or at least of the northern part which makes the separation between the great Carolinian Bay and the Gulf of Mexico), we have not only geological but zoölogical evidence. Although, as shown above, the littoral fauna* of that part of the gulf which bathes the west coast of Florida is of a character far more tropical than that of the east coast, the fauna of the latter is reproduced in the northwestern part of the gulf. The correspondence between the shells of Galveston and those of South Carolina was noticed by Roemer many years ago, and the fact is now confirmed by an examination of the shells brought by Dr. Durham from several points on the coast between Point Isabel and Pensacola. The peninsula and warm waters of the southern cape of Florida now form an impassable barrier to the western migration of species of the temperate fauna into the colder parts of the gulf, but of their connection within a comparatively recent geological period there can be no doubt. The connection was probably through sandy straits and lagoons, too shallow to allow of the passage of the gulf-stream, but perhaps permitting the westward flow of the cold waters of the Carolinian Bay.

The present tropical character of the shells of the west coast of Florida is plainly due to the influence of the gulf-stream, which is not here, as in the northwestern part of the gulf, crowded off the shores by the waters of a great river, or by cold northwest winds. On the other hand the east coast, as far south as Cape Canaveral, forms a part of the shore of the Carolinian Bay, along which, inside of the gulf-stream, a cold current runs, giving to this part of Florida a coast fauna similar to that of South Carolina.

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* By the *littoral* fauna, that of the true ocean shores is here meant. The waters of the shallow inlets and estuaries of the west coast are subject to great changes of temperature, which, during the winter "northers," may fall to the freezing point, at which times fish caught in such places die in great numbers. As might be expected, the fauna of these inlets is very different from that of the beaches, and such northern forms as *Modiola plicatula* and *Cardium Mortoni*, which are adapted to such extremes of temperature, find here a congenial station.

THE BORERS OF CERTAIN SHADE TREES.

BY A. S. PACKARD, JR.

In no way can the good taste and public spirit of our citizens be better shown than in the planting of shade trees. Regarded simply from a commercial point of view one cannot make a more paying investment than setting out an oak, elm, or maple or other shade tree about his premises. To a second generation it becomes a precious heirloom, and the planter is duly held in remembrance for those finer qualities of heart and head, and the wise forethought which prompted a deed simple and natural, but a deed too often undone. What an increased value does a fine avenue of shade trees give to real estate in a city? And in the country the single stately elm rising gracefully and benignantly over the wayside cottage, year after year like a guardian angel sending down its blessings of shade, moisture and coolness in times of drought, and shelter from the pitiless storm, recalls the tenderest associations of generations after generations that go from the old homestead.

Occasionally the tree, or a number of them, sicken and die, or linger out a miserable existence, and we naturally after failing to ascribe the cause to bad soil, want of moisture or adverse atmospheric agencies, conclude that the tree is infested with insects, especially if the bark in certain places seems diseased. Often the disease is in streets lighted by gas, attributed to the leakage of the gas. Such a case has come up during the past year at Morristown, New Jersey. An elm was killed by the Elm borer, *Compsidea tridentata* of Olivier, and the owner was on the point of suing the Gas Company for the loss of the tree from the supposed leakage of a gas pipe. While the matter was in dispute, Mr. W. C. Baker of that city took the pains to peel off a piece of the bark and found, as he writes me,

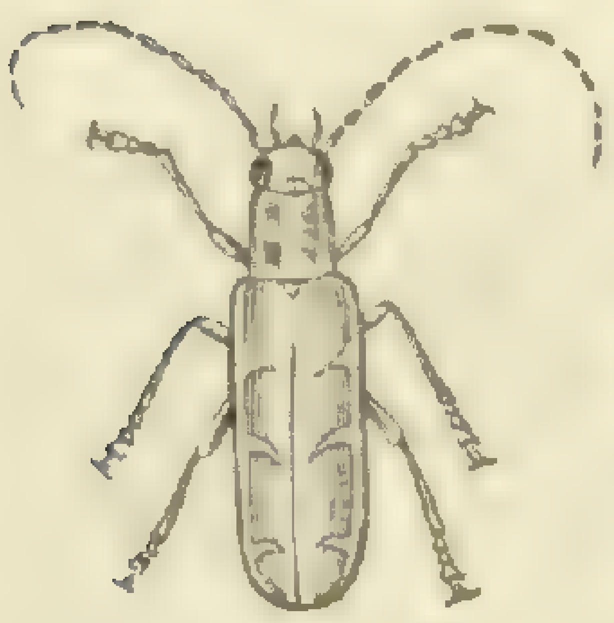
"great numbers of the larvæ of *C. tridentata* in the bark and between the bark and the wood, while the latter is 'tattooed' with sinuous grooves in every direction and the tree is completely girdled by them in some places. There are three different sizes of the larvæ, evidently one, two and three years old, or more properly six, eighteen and thirty months old." The tree had to be cut down.

Dr. Harris, in his Treatise on injurious insects, gives an account of the ravages of this insect which we quote: "On the 19th of June, 1846, Theophilus Parsons, Esq., sent me some fragments of bark and insects which were taken by Mr. J. Richardson from the decaying elms on Boston Common, and among the insects I recognized a pair of these beetles in a living state. The trees were found to have suffered terribly from the ravages of these insects. Several of them had already been cut down, as past recovery; others were in a dying state, and nearly all of them were more or less affected with disease or premature decay. Their bark was perforated, to the height of thirty feet from the ground, with numerous holes, through which insects had escaped; and large pieces had become so loose, by the undermining of the grubs, as to yield to slight efforts, and come off in flakes. The inner bark was filled with burrows of the grubs, great numbers of which, in various stages of growth, together with some in the pupa state, were found therein; and even the surface of the wood, in many cases, was furrowed with their irregular tracks. Very rarely did they seem to have penetrated far into the wood itself; but their operations were mostly confined to the inner layers of the bark, which thereby became loosened from the wood beneath. The grubs rarely exceed three-quarters of an inch in length. They have no feet, and they resemble the larvæ of other species of *Saperda*, except in being rather more flattened. They appear to complete their transformations in the third year of their existence.

"The beetles probably leave their holes in the bark during

the month of June and in the beginning of July; for, in the course of thirty years, I have repeatedly taken them at various dates, from the 5th of June to the 10th of July. It is evident, from the nature and extent of their depredations, that these insects have alarmingly hastened the decay of the elm-trees on Boston Mall and Common, and that they now threaten their entire destruction. Other causes, however, have probably contributed to the same end. It will be remembered that these trees have greatly suffered, in past times, from the ravages of canker-worms. Moreover, the impenetrable state of the surface-soil, the exhausted condition of the subsoil, and the deprivation of all benefit from the decomposition of accumulated leaves, which, in a state of nature, the trees would have enjoyed, but which a regard for neatness has industriously removed, have doubtless had no small influence in diminishing the vigor of the trees, and thus made them fall unresistingly a prey to insect-devourers. The plan of this work precludes a more full consideration of these and other topics connected with the growth and decay of these trees; and I can only add, that it may be prudent to cut down and burn all that are much infested by the borers."

Fig. 115.



Compsidea tridentata.

Fig. 116.

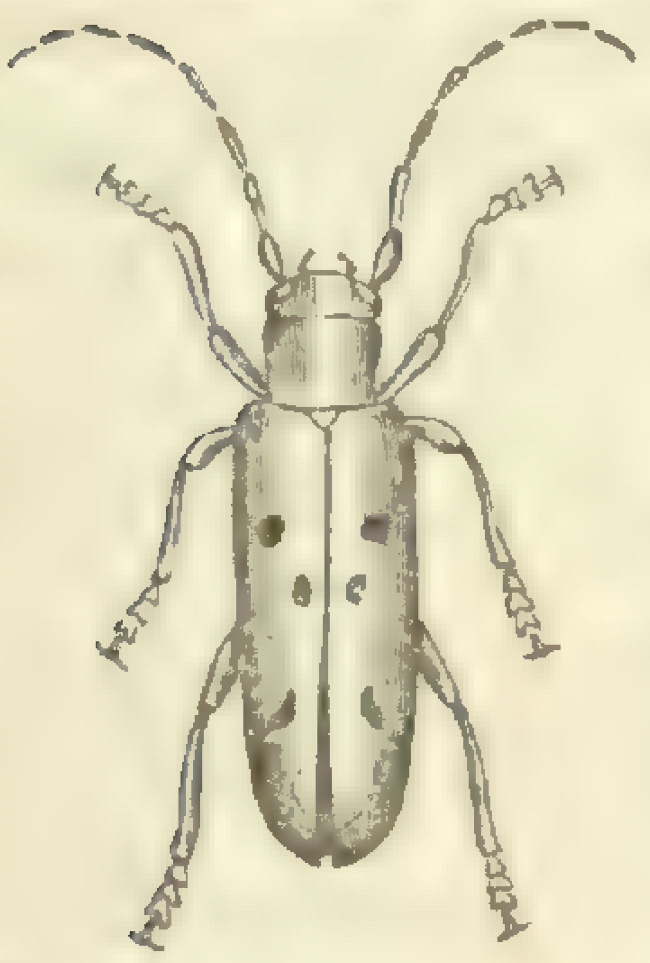
Larva of *Compsidea tridentata.*

The Three-toothed Compsidea (Fig. 115), is a rather flat-bodied, dark brown beetle, with a rusty red curved line behind the eyes, two stripes on the thorax, and a three-toothed stripe on the outer edge of each wing cover. It is about one-half an inch in length.

The larva (Fig. 116, drawn from the living specimen) is white, subcylindrical, a little flattened, with the lateral fold of the body rather prominent; the end of the body is flattened, obtuse, and nearly as wide at the end as at the first abdominal ring. The head is one-half as wide as the pro-

thoracic ring, being rather large. The prothoracic, or segment just behind the head, is transversely oblong, being about twice as broad as long; there is a pale dorsal corneous transversely oblong shield, being about two-thirds as long as wide, and nearly as long as the four succeeding segments; this plate is smooth, except on the posterior half, which is rough, with the front edge irregular and not extending far down the sides. Fine hairs arise from the front edge and side of the plate, and similar hairs are scattered over the body and especially around the end. On the upper side of each segment is a transversely oblong ovate roughened area, with the front edge slightly convex, and behind slightly arcuate. On the under side of each segment are similar rough horny plates, but arcuate in front, with the hinder edge straight.

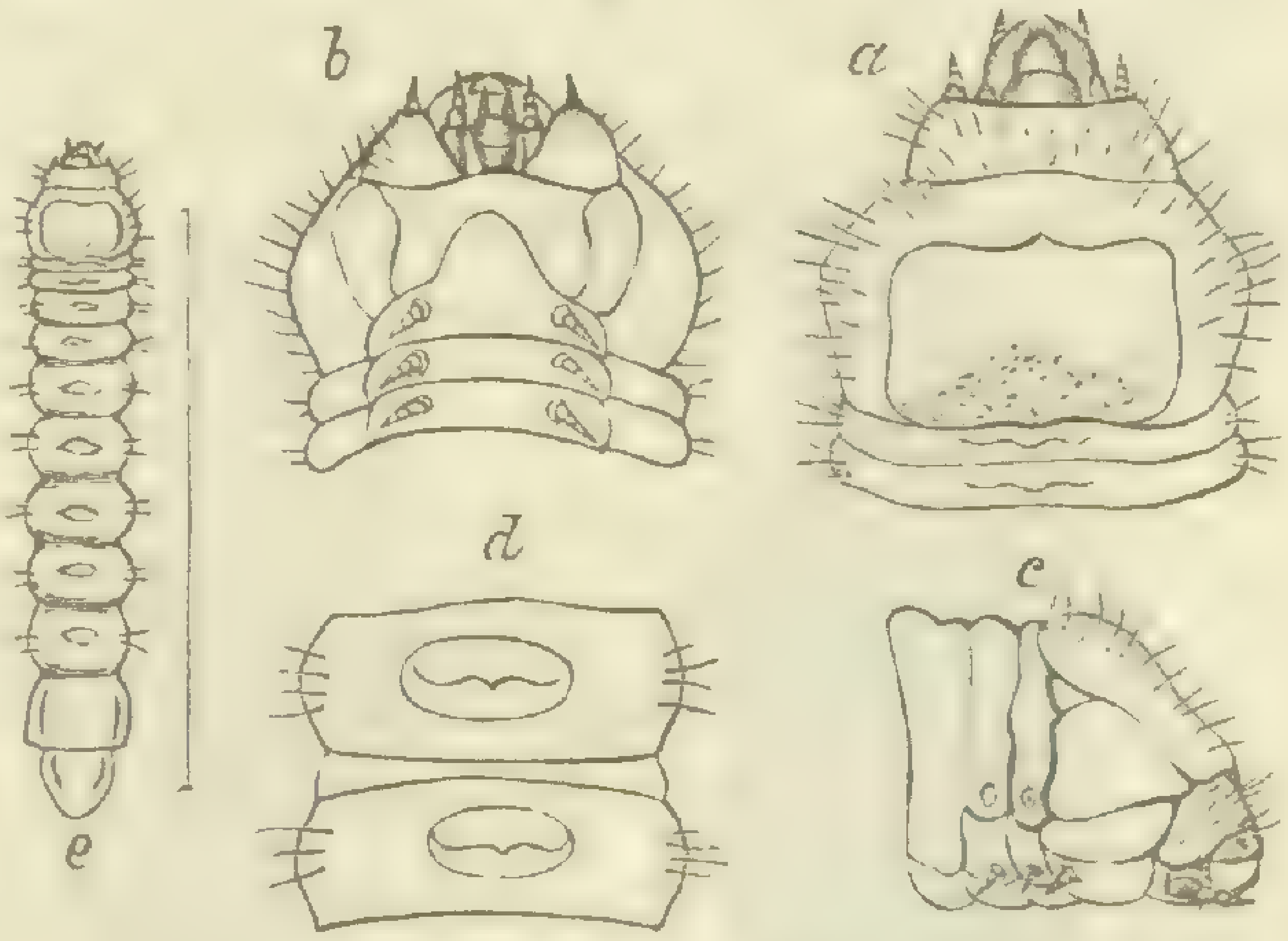
Fig. 117.



Saperda vestita.

It differs from the larva of *Saperda vestita* Say, in the body being shorter, broader, more hairy, with the tip of the abdomen flatter and more hairy. The prothoracic segment is broader and flatter, and the rough portion of the dorsal plates is larger and less transversely ovate. The structure of the head shows that its generic distinctness from Saperda is well founded, as the head is smaller and flatter, the clypeus being twice as large, and the labrum broad and short, while in *S. vestita* it is longer than broad. The mandibles are much longer and slenderer, and the antennæ are much smaller than in *S. vestita*.

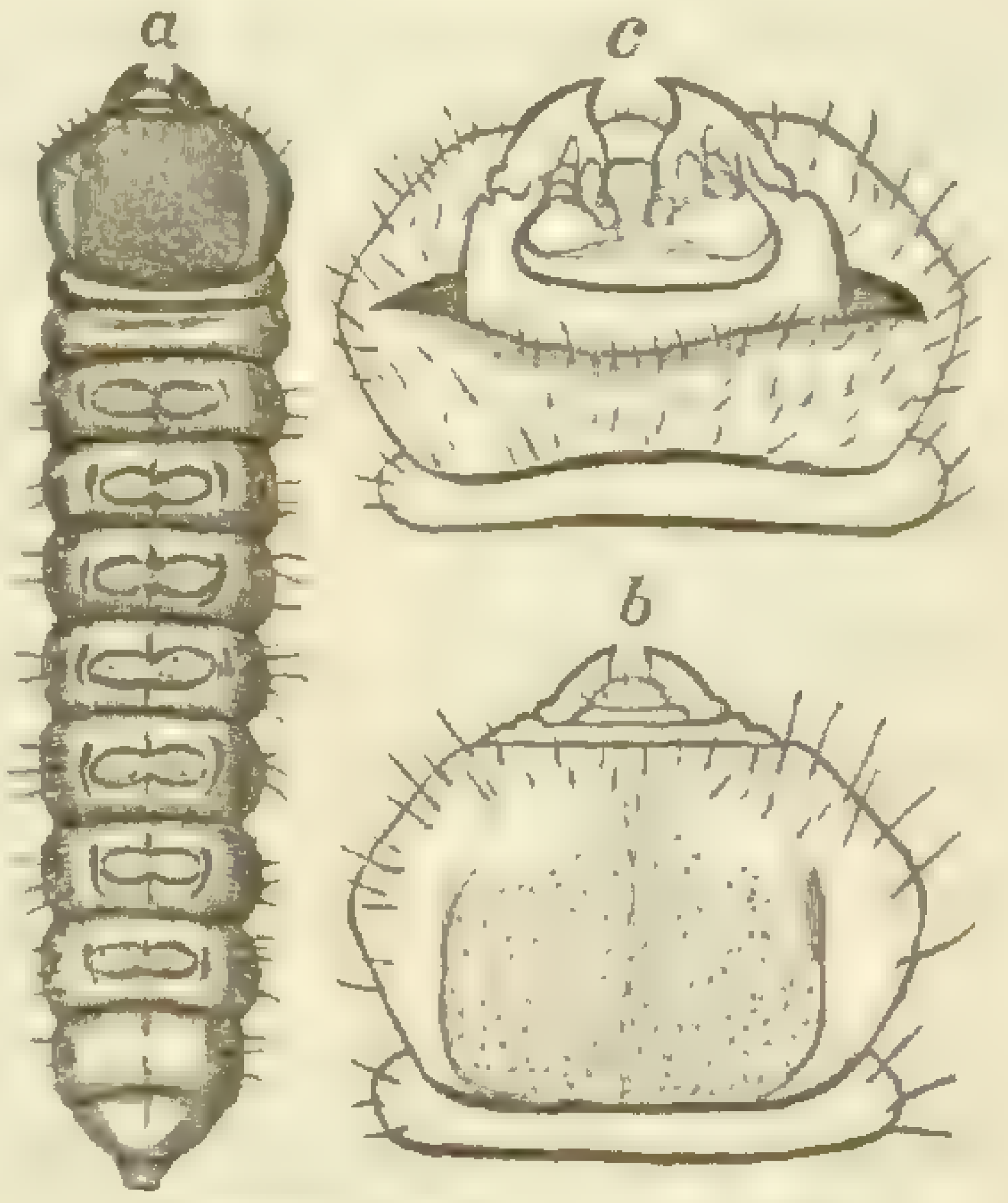
Fig. 118.



Saperda vestita, larva.

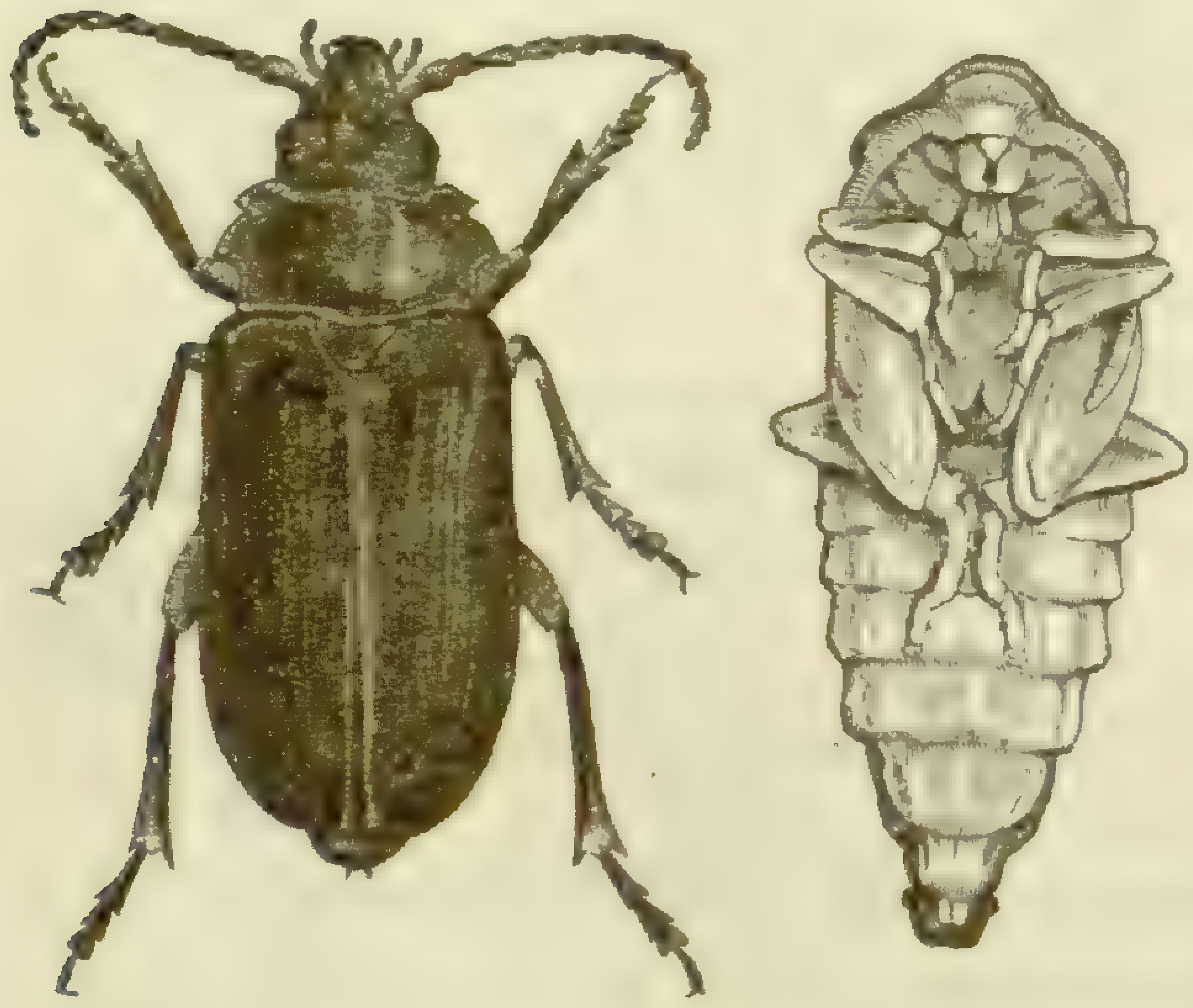
The Linden Tree-borer (*Saperda vestita* of Say, Fig. 117) is a greenish snuff yellow beetle, with six black spots near the middle of the back; and it is about eight-tenths of an inch in length, though often smaller. The beetles, according to Dr. Paul Swift, as quoted by Dr. Harris, were found (in Philadelphia) upon the small branches and leaves on the 28th day of May, and it is said that they come out as early as the first of the month, and continue to make their way through the back of the trunk and large branches during the whole of the warm season. They immediately fly into the top of the tree, and there feed upon the epidermis of the tender twigs, and the petioles of the leaves, often wholly denuding the latter, and causing the leaves to fall. They deposit their eggs, two or three in a place, upon the trunk or branches, especially about the forks, making slight incisions or punctures for their reception with their strong jaws. As many as ninety eggs have been taken from a single beetle. The grubs (Fig. 118*e*; *a*, enlarged view of the head seen from above; *b*, the under view of the same; *c*, side view, and *d*, two rings of the body enlarged), hatched from these eggs, undermine the bark to the extent of six or eight inches, in sinuous channels, or pen-

Fig. 119.



Saperda calcarata, larva.

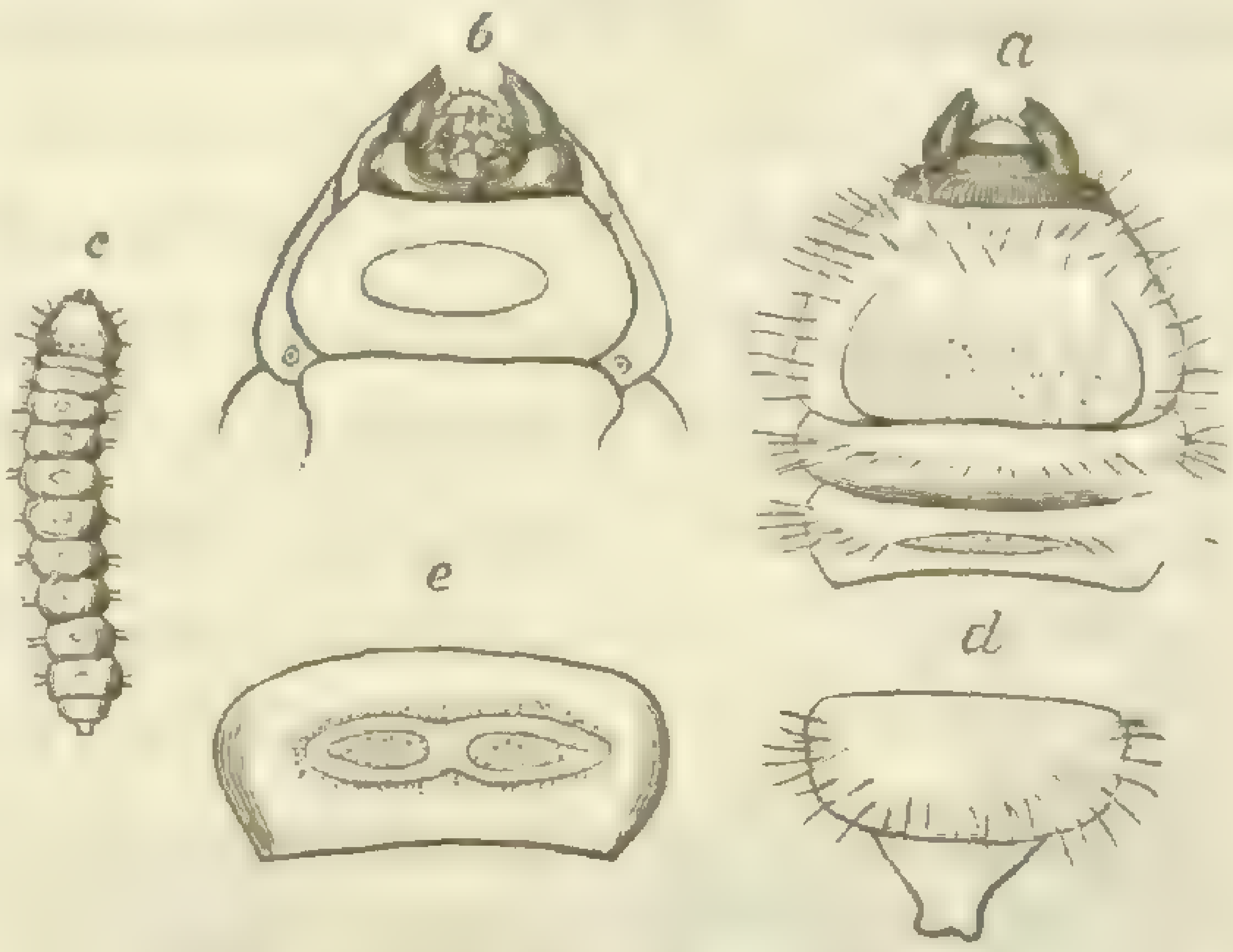
Fig. 120.



Prionus brevicornis and pupa.

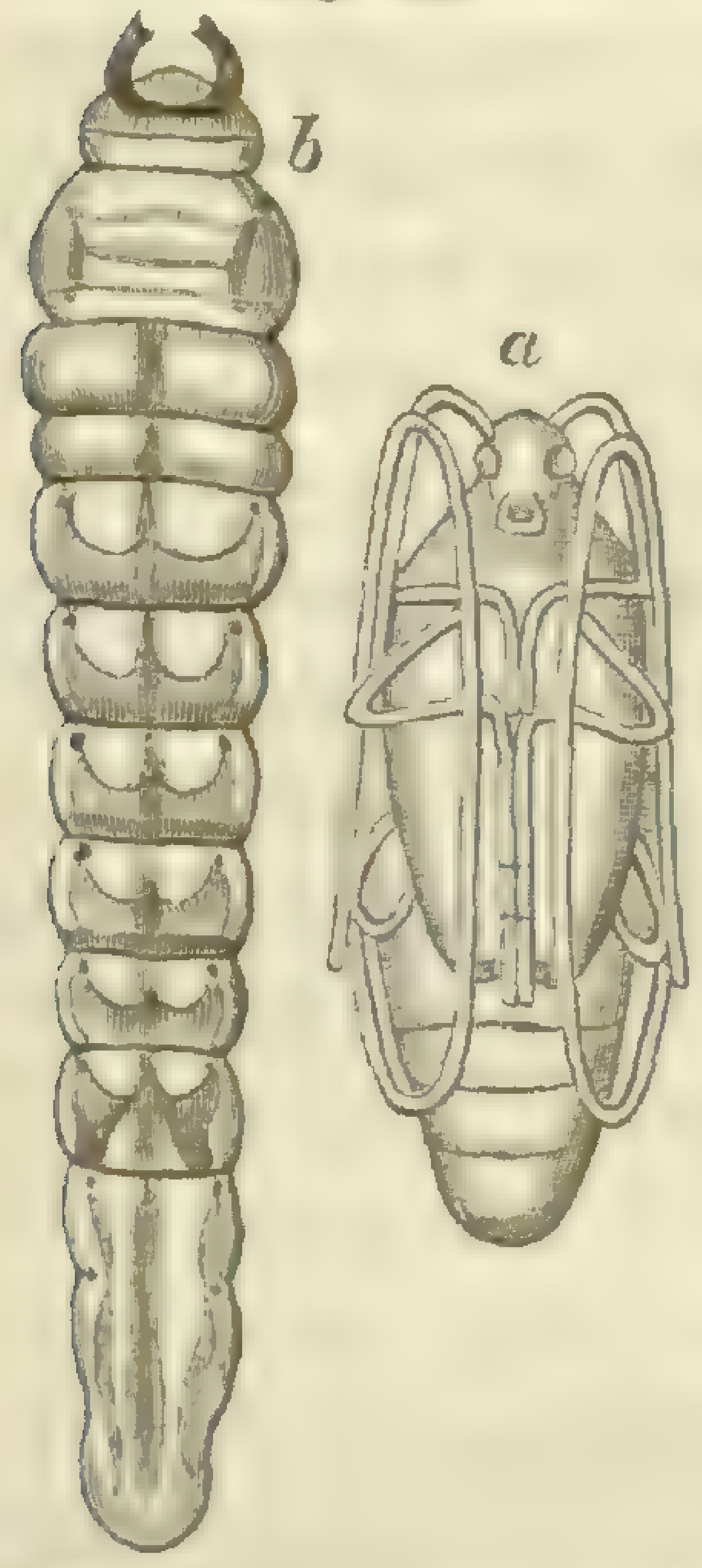
etrate the solid wood an equal distance. It is supposed that three years are required to mature the insect. Various expedients have been tried to arrest their course, but without effect. A stream, thrown into the tops of trees from the hydrant, is often used with good success to dislodge other insects; but the borer-beetles, when thus disturbed, take wing and hover over the trees till all is quiet, and then alight and go to work again. The trunks and branches of some of the trees have been washed over with various preparations without benefit. Boring the trunk near the ground, and putting in sulphur and other drugs, and plugging, have been tried with as little effect.

Fig. 121.



Saperda inornata and larva.

Fig. 122.



Monohammus titillator, larva and pupa.

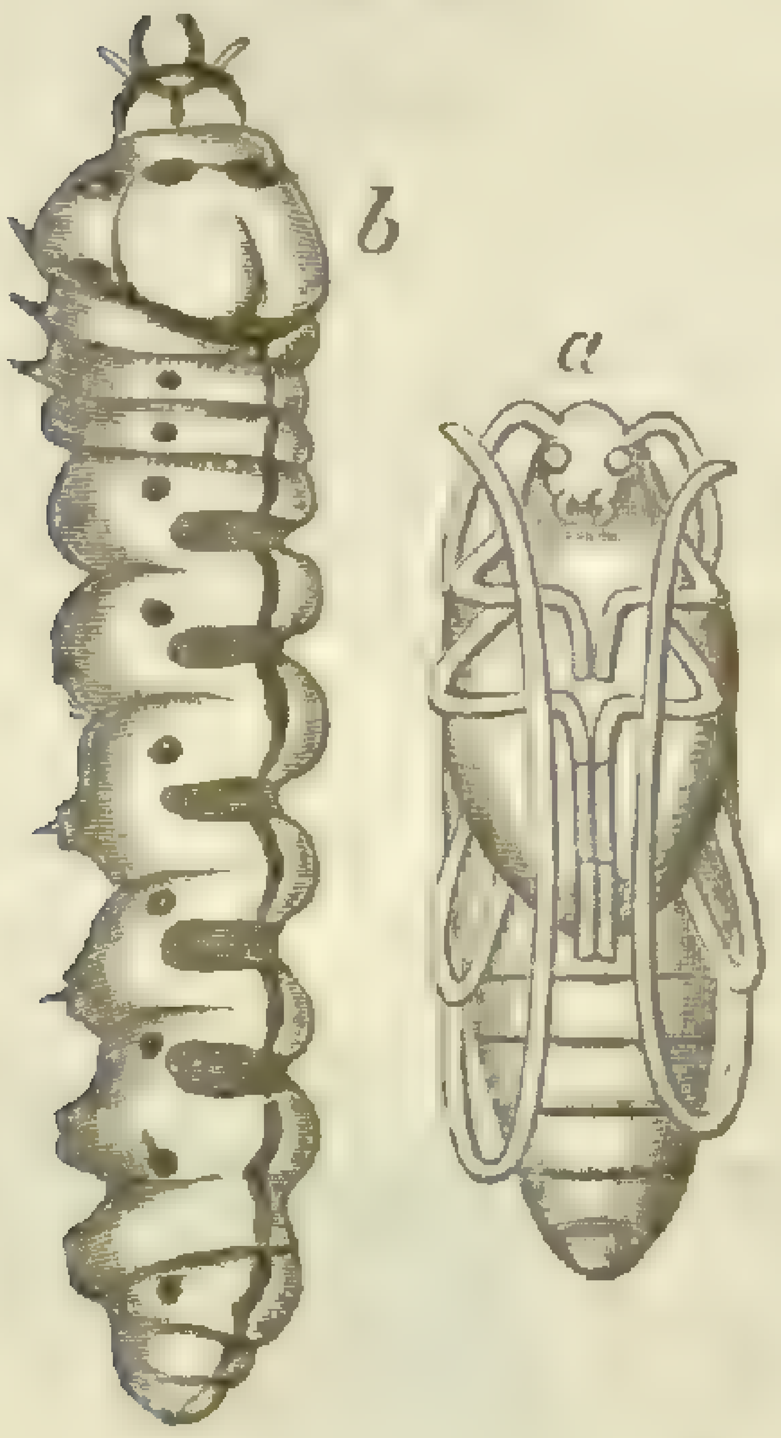
The city of Philadelphia has suffered grievously from this borer.

Dr. Swift remarks, in 1844, that "the trees in Washington and Independence Squares were first observed to have been attacked about seven years ago. Within two years it has been found necessary to cut down forty-seven European lindens in the former square alone, where there now remain only a few American lindens, and these a good deal eaten." In New England this beetle should be looked for during the first half of June.

The Poplar tree is infested by another species of Saperda (*S. calcarata* of Say). This is a much larger beetle than

those above mentioned, being an inch or a little more in length. It is gray, irregularly striped with ochre, and the wing-covers end in a sharp point. The grub (Fig. 119 *a*; *b*, top view of the head; *c*, under side) is about two inches long and whitish yellow. It has, with that of the Broad-necked Prionus (*P. laticollis* of Drury, Fig. 120 and pupa), as Harris states, "almost entirely destroyed the Lombardy poplar in this vicinity (Boston). It bores in the trunks, and the beetle flies by night in August and September. We also figure the larva of another borer (Fig. 121 *c*; *a*, top view of the head; *b*, under side; *e*, dorsal view of an abdominal segment; *d*, end of the body, showing its peculiar form), the *Saperda inornata* of Say, the beetle of which is black, with ash gray hairs, and without spines on the elytra. It is much smaller than any of the foregoing species, being nine-twentieths of an inch in length. Its habits are not known. We also figure, from the manuscript work of Abbot, the larva and pupa (Fig. 122, *a*, pupa; *b*, larva) of *Monohammus titillator* of Fabricius, but he does not state on what tree it feeds. We copy also a figure of the larva and pupa of *Chion cinctus* (Fig. 123, *a*, pupa; *b*, larva), from the same work. The author gives no account of its habits.

Fig. 123.



Chion cinctus, larva and pupa.

SPRINGTIME ON THE YUKON.

BY W. H. DALL.

HAVING joined the readers of the NATURALIST in a winter day's journey on the Ulukuk portage not long since, we may, if so inclined, try our fortune again together, in the

more pleasant springtime, and gather what facts we may of interest and value during another day, spent on the great river of the northwest, and its shores.

The spring, after the middle of March, comes on with eager steps in the Yukon Territory. The days lengthen so rapidly that the change is almost perceptible from one day to another. The great snow blanket, from six to eight feet thick, which covers the whole country, sinks and hardens from day to day. A tremulous mist, quivering like the hot air above a heated iron, hovers over the brilliant surface of the snow crust, and to this is due the painful inflammation of the eyes (conjunctivitis) which is only too familiar to the northern voyageur under the name of "snow blind." To avoid it, we don a pair of dark green glass goggles, or the wooden goggles of the Eskimo, which admit the light only through a narrow slit in the blackened wood, warding off the reflected light; yet even through these the surface of a hill or river appears most dazzling, so intense is the snow glare. Early in April the long hot days and short nights are felt and their results indicated, by the water which covers and softens the ice sheets on lakes and rivers. Shirt sleeves are the rule, and open casements let in the unaccustomed sunlight without stint, while the dark parchment windows of winter are laid aside.

On the tenth of April, though the whole country was white with the half melted snow sheet, flies, to all appearance the familiar blue bottle and housefly, clustered in myriads on the sunny side of the wall of the Nuláto trading post. The same day I found the velvety crimson catkin of the alder (how many of our readers have ever seen it?) side by side with the silvery one of the river willow, and searching among the poplars for new arrivals, brought down a white-winged crossbill, the first of the season. A day or two later, the turfed roof of my log dwelling was alive with small steel green beetles, redolent with a musky odor, and by carefully scanning the few spears of dry grass and green

tufts of moss which appeared above the surface of the snow, I found several other smaller species sunning themselves, unconscious of the presence of an enemy. The short-tailed field mice (*Arvicola xanthognathus* and *A. Gapperi*) were waking up to a sense of the situation and enjoying themselves on the river bank wherever a projecting root or stone offered a shelter from the keen eyes of the numerous hawks which ever and anon sailed overhead. Another reason for coming abroad was, that the melting snow was making their underground establishments very damp and uncomfortable.

The Canada jay, known all over the northern country by the less euphonious name of "whiskey jack," had already laid and almost hatched its eggs. The goshawk and the duck-hawk (*Astur atricapillus* and *Falco anatum*) had put their nests in order, and some of them had one egg as an earnest of what was coming. The ptarmigan (*Lagopus albus*) began to show rich dark brown feathers on the head and neck and on the edges of the wings. Owls (*Syrnium cinereum*, *Nyctea nivea*, *Nyctale Tengmalmi*, etc.), were abundant and attending to pressing domestic affairs.

Toward the end of April I climbed a tall, dead stump, once a noble birch (*Betula incana?*), and found, in the cavity at the upper end, six smooth white eggs. While transferring them to my knapsack the head of the family came home, and careless of personal risk or even death, dashed wildly about my head, knocking off a loose cloth cap which I wore, and screaming with sorrow and anger. The female owl, for it was a hawk owl's nest (*Surnia ulula*), soon joined him; and they flew to the top of a neighboring spruce, uttering cries of indignation to each other. Reaching the ground I soon quieted them, bringing both down with a single shot, and thus devoted the whole family to the interests of science.

On the third of May, Kurilla, my indefatigable Indian hunter, killed a white-cheeked brant (*Bernicla leucopareia*) and two ducks, a mallard and a golden eye (*Bucephala

Americana), receiving therefor the usual perquisite of a pound of tobacco for the first goose of the season. From this time forward, wild fowl might be expected in abundance. On the twelfth of May the ice came down with a rush in the small rivers; and that on the Yukon grew every day more unsafe. No salmon were to be expected for some weeks, but large numbers of "blanket fish" (a species of *Thymallus*) were to be seen ascending the small rivers. They would not take the hook, though the greatest inducements were offered, nor will any other fish found in the Yukon, as far as I know.

The ice on the Yukon breaks up about the twentieth of May. The earliest season known for many years brought open water on the sixteenth, and the latest on the twenty-fifth of the month.

On the twentieth of May I saw a fine specimen of the Camberwell beauty (*Vanessa antiopa*) and after that other butterflies were not uncommon, though they are more plenty toward the middle of June.

Waiting until the ice and logs are well out of the river and the freshet has somewhat subsided, let us take a small skin canoe and spend a day on the river. The sun is bright and warm; the weather clear and delightful; every living thing is pulsating with the energetic life of the Arctic spring. A gun, ammunition, axe, teakettle, and a few other indispensable articles constitute our equipment.

Shoving off from the muddy shore of the Nuláto river-bank, the blood springs, and the nerves tingle with the smart strokes of the paddle, which send us shooting over the turbid waters; laden as they are with sticks, refuse, and small cakes of ice, the remnants of the freshet, which last has carried the heavier logs and larger fragments seaward some days ago.

Hugging the bank to avoid the swifter current, the feathery willows and glistening tender leaves of the poplar (*P. balsamifera*) overshadow us, and small curculionid

beetles frequently drop into the boat from the overhanging boughs finding a safe harbor in our collecting bottles. The species are numerous but the individuals few. Two or three Indians in their small, frail, birch canoes, accompany us, on their way to some small river flowing into the Yukon. There they will spend a week or two hunting the beaver, driven from his house by the rise of the spring floods. These dusky aborigines notice our eager capture of beetles, and such small game, with unconcealed amusement, but are keenly alive to the fact that good specimens will buy needles, caps, or tobacco, and regulate their actions accordingly. As we round a bare point where the sun shines warmly on the fragrant grass and the saxifrage is already in blossom, a flight of swallow-tailed butterflies (*Papilio Turnus* and *P. Aliaska*) come sailing along, and immediately all is excitement. Paddles are wildly brandished in the air, the light canoes dart swiftly hither and thither, and the unconscious insects, thus assailed, escape with a loss of half their number. Then our Indian companions, with some incomprehensible witticism passing between themselves, bring in the results of their foray, and so some eight or ten passable specimens are added to our collection at the expense of a few needles and half a dozen percussion caps.

Away go the light canoes again, keeping admirable time with their paddles to a chant of which the following may be taken as a free translation: —

Where is the salmon, the big chief salmon?
Ha! He! Ha! Hah! Hah! Hah!
His sides are scarlet, his tail is mighty,
Ha! He! Ha! He! Ha! Ha!
Fat and luscious the steam of the kettle;
Hunger flies, when the salmon rises;
Rich and sweet are the tails of beaver,
Fat the deer, in the summer season,
And the bear in the early autumn;
Better still is the great fat salmon!
Ho! Ho! Ho! Ha! Ha! Ha!

and so on with an indefinite amount of interpolated chorus.

A little break in the green bank, where a small stream

dashes its clear cold water into the muddy Yukon-tide, offers an inviting nook, and into it we haul our bark, and, making fast to a projecting willow root, scatter in search of "specimens." A tough climb of ten minutes takes us to the top of the brown sandstone bluff, broken and weatherworn; yet showing, in its successive layers of clayey and sandy rock with thin laminæ of fossil vegetable matter, that, in ages gone by, the same forces were at work there, that we now observe on the recent river bank; each series of three layers shows how some flood came down and deposited first its sand, next its clay in the form of fine mud, and lastly any fragments of wood or vegetable matter which the receding waters left behind them. In the rocks above, however, a different state of things may be observed. Instead of the fragments of leaves of sycamores (*Platanus*), of carbonized wood, and of unrecognizable vegetable matter, we find remains of *fuci*, here and there a fragment which may have been of terrestrial origin; and, especially, remains of mollusca, mostly bivalves, such as oysters, mussels, and similar shell-fish, and very rarely a mass of remains which may once have been a fish. These fossils, though metamorphosed, broken, crushed, and frequently existing only as casts, are sufficient to indicate a miocene age for the rocks in which they occur, and no fossils of the older rocks have yet been found on the lower Yukon.

By turning over some of these prostrate trunks we shall obtain rare prizes in the shape of *Carabidæ*, beetles, frequently of brilliant colors and large size, of which some are so rare that an enthusiastic entomological friend once exclaimed to us, when parting: "Oh, if I thought I could discover the *Carabus Vittinghœvii*, I think I should leave my business and go with you!" In the same locations are to be found minute land shells (*Helix chersina*, *striatella*, *electrina* and others, as well as minute species of *Pupilla* and *Vertigo*, all common to the northern zone of the world, from Sweden to Labrador, though known under various local names.

Diptera, in the shape of mosquitoes, are only too common, as we have discovered long since, and one does not wonder that the deer and moose, to escape their persecution, plunge into the Yukon under the very eye of the hunter, to meet a certain doom.

Birds of the season are vocal in every bush; and here again we meet familiar acquaintances, perhaps the very same which have built their nests and reared their young under the roses and lilacs of Massachusetts. The common robin (*Turdus migratorius*), the much more beautiful and musical varied thrush (*T. nævius*), the gray-cheeked thrush (*T. aliciæ*), the ruby-crowned kinglet (*Regulus calendula*), the yellow, black-capped, and yellow-rumped warblers (*Dendroica æstiva*, *striata* and *coronata*), the wax wing (*Ampelis garrulus*), the rusty blackbird (*S. ferrugineus*), and a host of others are everywhere about us, hardly noticing our presence, and intent on pleasing their newly found mates, by song, and twitter, and pretty, arch gymnastics, which, to the tender-hearted make the use of powder and shot, even for scientific purposes, little better than deliberate murder. Kurilla, at our side, says "the bushes are boiling over with birds!" And this reminds us that the sun is now high in the south, and we make our way toward the boat abandoning sentiment to boil the teakettle. On our way, a few low musical notes attract our attention just in time for us to see the author, a water ouzel (*Hydrobata Mexicana*), dive with a splash and patter into the little brook before us, and away, out of sight. Yonder is a beautiful rounded dome of moss, woven as closely as a Turkey carpet, and as smooth and even as the dome of St. Peter's, with a small round hole at one side, where our timid songster in due time will rear his family. Kurilla's gun is ever ready; he has reached the waterside before us and a magnificent mallard lies at his feet, which he has just shot, as it rose from yonder stump hidden in a bunch of alders. Parting the bushes we see him point triumphantly to an excavation in the decayed wood where

lie six eggs, just laid and left in an evil moment by the parent. While we are thinking of the bereaved mother Kurilla's thoughts tend toward omelets, and the frying pan and a piece of deer-fat are soon produced. Duck roasted on a stick before the fire, is quite another thing from the embalmed remains which the hotels offer us, by way of game, and to our mind it is far superior. Our meal of duck, omelet, tea and bread being finished, we seat ourselves in the boat, cast off the lashings, and shoot out into the rapid current, leaving the mosquitoes, for a time at least, behind us; when, an hour afterwards we haul up on the beach at Nuláto and survey our trophies, some of us may conclude that pleasure as well as profit may be found, even in the wilderness which borders on the Yukon.

THE IMPREGNATION OF EGGS IN TROUT BREEDING.

BY A. S. COLLINS.

Four or five years ago the subject of this article would have been considered of little practical importance. Now, however, fish-breeding establishments in our country can be counted by the hundred; and every detail of the business is receiving close attention. I propose briefly to describe the method in which trout naturally impregnate their eggs, and then the various methods or modifications adopted by fish-breeders.

Natural Method of Spawning. Some time about the month of October (the time varying with the temperature of the water), the trout which have hitherto been scattered through the stream, begin to run up toward its sources. The place which they choose for a nest has always certain characteristics. It is chosen as near a spring head as possible,

having a gravelly bottom and being in comparatively swift water. But as these conditions are necessary only to the hatching of the eggs they need not be dwelt upon here. The females spawn but once in a season; the males, on the other hand, milt several times. So that there is always an excess of males. The females do not choose their partners. As soon as the female begins to make her nest some one of the males around swims to her side. If a stouter or pluckier male chances to come that way, a battle royal ensues, and the victor takes the place of the vanquished. This operation is often repeated, and it seems to make little difference to the female which one lies by her side. It is to be noted that by this order of nature, the healthiest and strongest trout pair together. When the female is ready to emit her eggs the male glides to her side, and his milt is emitted simultaneously with, and over her eggs. The male swims off, the female covers the eggs with gravel, and the operation is complete. This description of the action of spawning is very incomplete; but is sufficient for our present purpose, which is to compare with it the methods in use among trout breeders.

Stripping the Fish. This was the earliest method and is still in more extensive use than any other. At certain times the ripe males and females are taken from the races. By a very slight pressure of the hand, the milt is forced from a male into a pan partly filled with water; by a similar pressure the eggs of a female are forced as quickly as possible into the pan, and the operation is continued in the same order until all the fish are handled; the water being gently agitated from time to time with the hand or the tail of a fish. The eggs are then supposed to be impregnated and after standing some twenty or twenty-five minutes, are placed in the hatching troughs. This plan has its advantages; among which, the first and foremost is that more eggs can be impregnated in this way than in any other. If the eggs of a trout be taken from their bed in the natural stream and ex-

amined, it will be found in the majority of cases that a very small percentage are impregnated (in one case standing as low as six per cent). While by the stripping process anywhere from eighty-five to one hundred per cent. can be impregnated. If we consider that in natural spawning, the milt is ejected into comparatively swift water, which sweeps it almost immediately away from the eggs, we shall cease to wonder at the difference. Another advantage is that the eggs in the stripping process are exposed to the milt of several males; and as the milt of one male will impregnate thousands of eggs, if only one male out of a dozen used be good, we may fairly expect that all the eggs in the pan will be impregnated. It is also an incidental advantage of this process, that as the fish are all handled the stripped fish may be put into a spare pond, so that they may not again run up into the raceway and hinder those about to spawn. For this reason and also because it is not intended that the fish should lay any eggs, a race for stripping purposes takes up comparatively little room. On the other hand the disadvantages of the process are manifold; the principal one being that it is very difficult to take the eggs and milt at the precise time when the fish would naturally yield them. With much experience, however, a trout breeder will succeed very well in doing this, and at our own place* we would even now about as soon have stripped eggs *of our own taking* as any others. But a novice would not probably succeed very well. Another disadvantage is that the handling of a struggling fish is a thing to be avoided if possible. Even the most experienced can hardly help killing a few, and the least experienced will kill many. The bruised fish do not show the hurt at once, and will often live some weeks after receiving the injury. This difficulty increases with the size of the fish. The large fish which give the most eggs are the hardest to handle safely. Then the operation itself is not the most pleasant in the world. A ten or fifteen minutes immersion

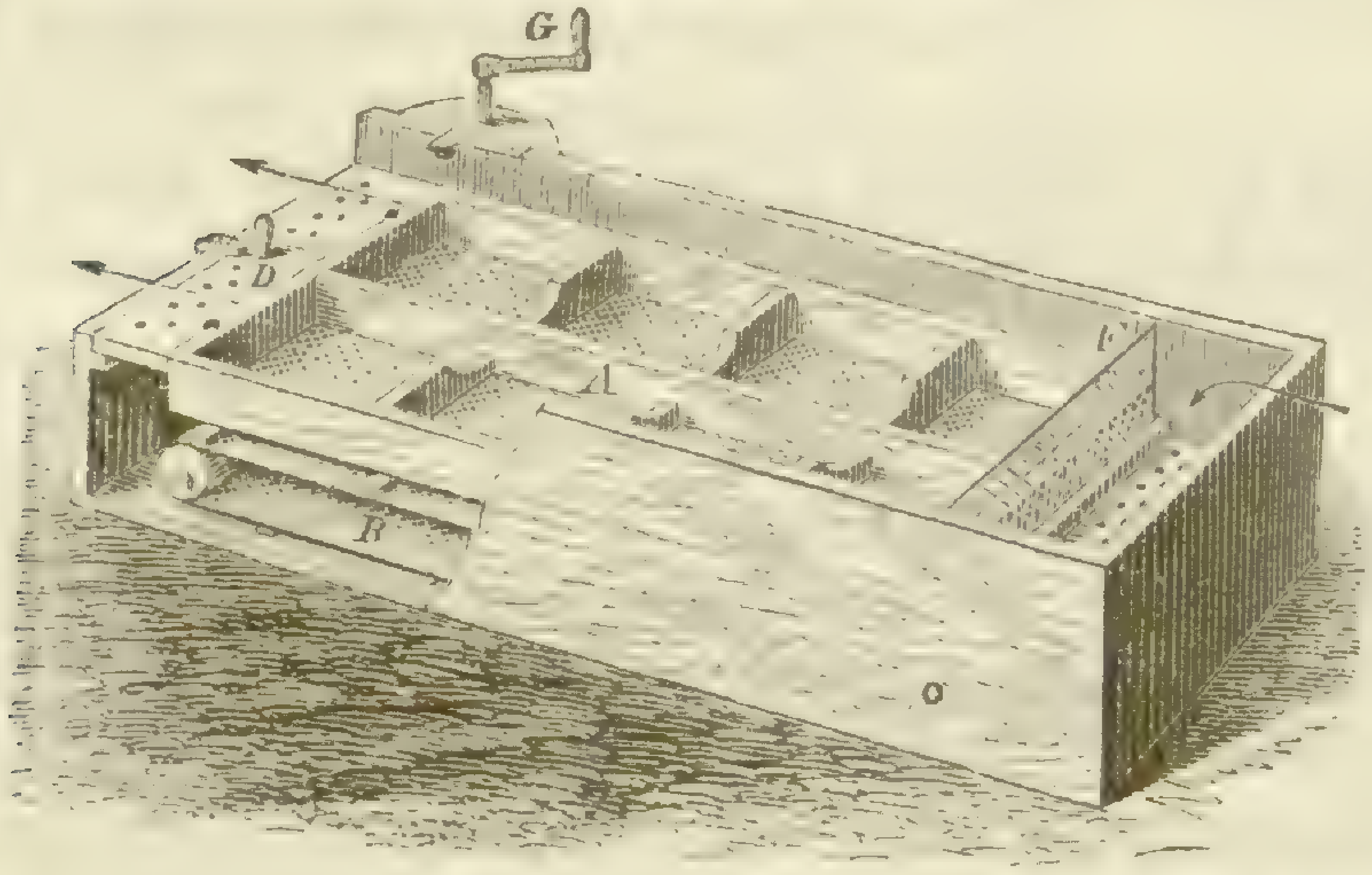
* Trout Ponds of Seth Green & Collins, Caledonia, N. Y.

of the hands in cold water in the middle of winter is not very desirable, and if this has to be repeated a half dozen times every day, it becomes a thing to be avoided if possible. Then, too, all the fish in the race have to be taken at the same time, whether ready or not; and the interruption to those who are just commencing to spawn is bad for many reasons besides the danger of handling them two or three times to see if they are ripe. These disadvantages and especially the first mentioned, induced Mr. Stephen H. Ainsworth to prepare and use what are known as the "Ainsworth Screens." This invention is an imitation of a natural trout bed. Coarse gravel is placed in a wooden frame two feet square and three or four inches high with a bottom of wire screen coarse enough to permit trout eggs to pass through readily. A similar frame with sides only one inch high and fine wire bottom is placed beneath the first, and both are sunk eight or ten inches in the raceway. Trout making their nests in the boxes lay bare the coarse screen. The eggs, being at the same time impregnated by the milt of the male, fall through the meshes of the upper screen and are caught and retained by the fine meshes of the under screen. The two frames fitting closely together make it impossible for any fish to get at the eggs, and they are kept safely until the screens are removed and the eggs taken to the hatching house. The advantages of this plan are very great; but they are obvious and may be summed up in a few words. There is no danger by this method of getting unripe or immature eggs, as the eggs are all naturally spawned. It is also certainly reasonable to suppose that a fish can do this part of the business best. There is also no danger of loss from handling the fish; and a comparative novice can take the place of a more experienced hand. Then in this way the fish select their own partners; and probably when left to themselves those pair which are best adapted to each other: whereas in the stripping process, the pairing is arbitrary and no rules for selection are known.

But the inconveniences attending this plan in its first shape were very great. The frames could not be made smaller than two feet square, as that is about the amount of space a trout requires for spawning. Nor could they be made larger, as the weight of the gravel on larger frames would render them unwieldly to handle. Therefore, in order to fill a trout race, a series of boxes—say from ten to forty is required. All these have to be looked over at least once every week during the season, and if there are many fish, two or three times a week. Each time the screens are looked over every fish is necessarily driven from the race, although they may be just commencing their nests, or in the very act of spawning. The upper screen with its load of gravel is first lifted out of the water. The lower screen will then float to the surface if it is not water-logged. The eggs lying upon it are brushed to one corner with a feather; a pan is placed underneath the corner, the screen is tipped up and the eggs feathered into the pan *sometimes*, for the current often sends them in any direction except into the pan, and cold fingers are not always reliable. India-rubber gloves are no protection from cold, nor woollen gloves from water; and the two combined are too clumsy for the purpose. After the eggs are taken, the fine screen is returned to its place, the upper screen fitted exactly to it and both sunk again to their place; unless as often happens a stone or two has fallen out of the frames upon the supporting ledges, in which case the screens have to be taken up again and the stones removed. It will take two men five or six hours to properly look over forty of these screens. In order to make this process easier the writer invented and patented what he calls the "Roller Spawning Box." This box answers for securing the *naturally impregnated* eggs of salmon, salmon trout, speckled brook trout, whitefish, shad, etc., etc. The principle used is that of the "Ainsworth Screens," and the improvement consists in a new and convenient method of collecting the eggs.

Figure 124 represents a small spawning box with a portion of the side removed. Figure 125 is an enlarged view of the front of the same box. At A is seen a double row of frames each two feet square with a bottom of coarse wire cloth. Instead of being made singly they are put together in one piece. These screens are to be filled with coarse gravel and the eggs pass through as in Ainsworth's screens. Under these is an endless apron of fine wire cloth, B, passing over rollers at the two ends of the box. This apron is about one inch beneath the upper screen, and is kept from

Fig. 124.



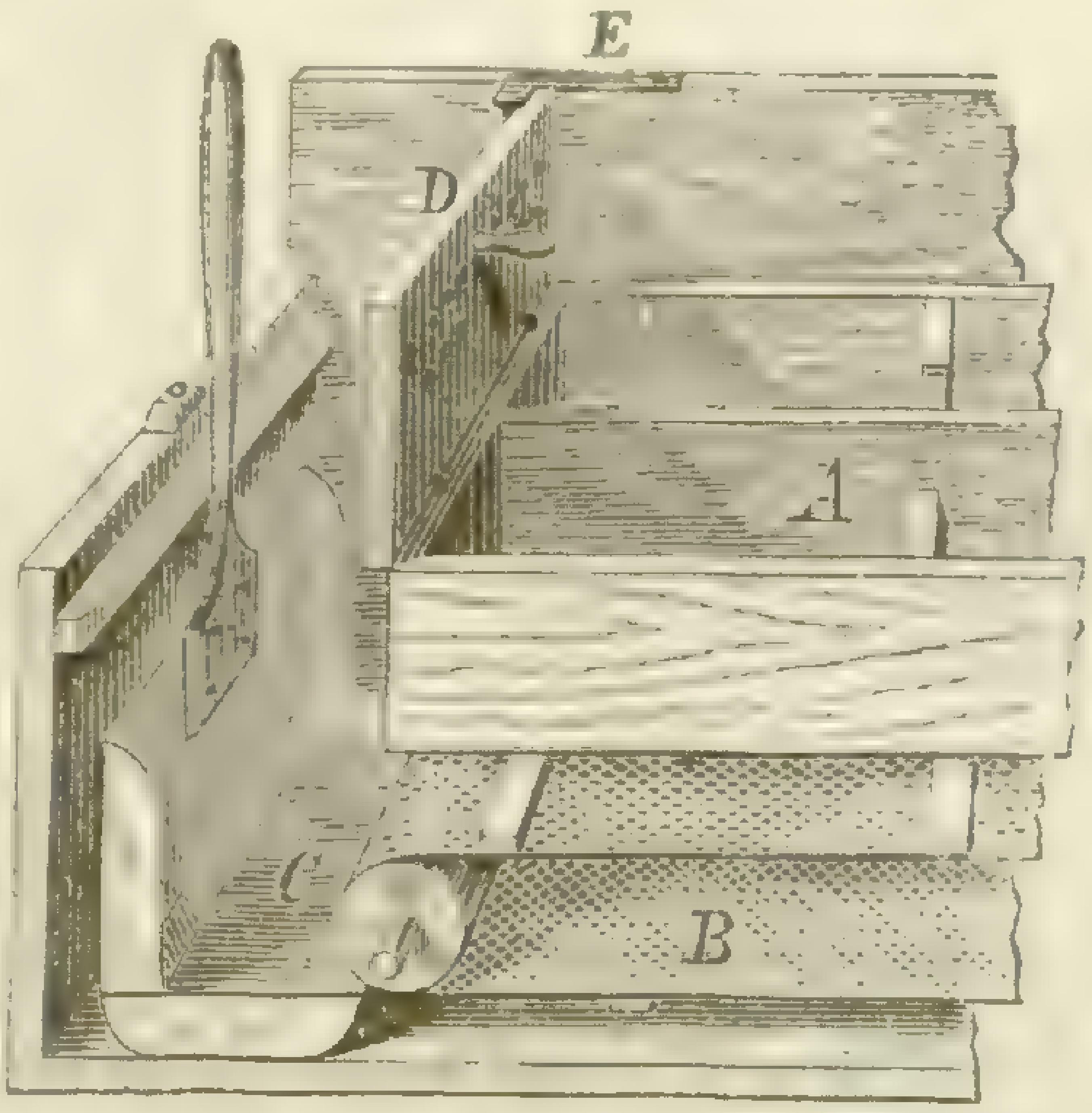
Roller Spawning Box.

sagging by small cross-bars (two of which are seen in the cut) corresponding to the divisions of the upper screen. These cross-bars are supported by and, when the rollers are turned, slide on an inch square strip nailed to the side of the box. A similar strip one inch above supports the larger screens.

The cross-bars also keep the eggs from being carried down by the current. By using two small beveled cog-wheels the front roller can be turned by the handle seen at G. As the roller is turned forward the endless apron moves with it, and the eggs as they come to the edge of the roller will fall off. The pan, C (fig. 125), is placed in front of the roller, and receives the eggs as they fall. The box need not be more

than two feet deep; the depth depending upon the size of the rollers, which in a short race may be quite small and the box not more than eighteen inches deep. The box is set directly in the raceway, and intended to fill it completely. The water enters in the direction of the arrows, and may either enter with a fall over the top of the box, as seen in fig. 124, or the top of the box may be cut down until the water will enter on the level at which it is intended to stand over the screens.

Fig. 125.



Front of Spawning Box.

F (fig. 124) is a screen intended to prevent the fish from running beyond the race, or getting into the lower part of the box. It may extend to the bottom, or be arranged as seen in the engraving. D is a screen at the front of the box, also intended to prevent the fish from getting below. When the eggs are to be taken this screen is raised on hinges to an upright position, and confined by a spring catch or latch as seen at E (fig. 125). This confines the fish which may happen to be in the race and none of them can get below. The pan is then lowered to its position, the roller turned and the eggs taken. When the operation is finished the screen D is again lowered, the button turned and the work is done. If the box is wide, say four feet, it is more convenient to have the pan made in two or three sections, inserted in a light frame, as the eggs can be more easily carried in and poured out of a shorter pan. It is better perhaps to make the screen D to open in the middle, having hinges at both sides. Then one half will keep the fish in the pond, and the other half the fish in the race, from running into the well. The box can be made of any length from four feet to forty

feet or even longer, and of any width from two feet to six or eight. If it is made very wide an additional longitudinal support must be provided for the revolving screen. We recommend the following dimensions for speckled trout races: two feet wide and from ten to twenty feet long; or four feet wide and from twenty to forty feet long. The upper screens may be made in convenient sections, the whole width of the box, and six or eight feet long.

The screens F and D are so made that while a full current is permitted to flow over the upper screens (A), only a gentle current can flow through the under part of the box. This current is meant to be so regulated that when the pan, C, is placed about an inch from the turning roller, all the small stones which the trout may whip through the upper screen will fall short of the pan; the eggs being lighter will be carried by the current into the pan, while a great part of the dirt, etc., which may collect on the under screen will be carried up over the pan and entirely out of the box. The revolving screen *may* be made of tarred muslin or some similar fabric. But wire cloth (of ten or twelve meshes to the inch) keeps much the cleanest and we are inclined to think it best for the purpose. I make my aprons, half wire cloth and half tarred muslin, furnishing the wire only with cross-bars and always leaving it uppermost. This apron is fastened around the rollers by a lacing of cord. At the end of the season the water in the pond can be drawn down a foot and everything taken out but the rollers. Give the screens a coat of paint or gas tar and lay them away in a dry place until the next autumn. A stiff brush may also be placed under the forward roller, so that every time the roller is turned to remove the eggs the screen will be perfectly cleaned.

A few of the advantages of the plan are as follows: Let us compare a double row of forty Ainsworth screens, each two feet square and occupying a space in the raceway forty feet long and four feet wide, with one of the new spawning boxes of the same dimensions.

1st. By the old way it would take two men a good half day to remove the screens singly, feather off the eggs in a careful manner, and return each (double) screen to its proper place.

It would take the new spawning box about fifteen minutes to do the same work with one man.

2d. The weight of the gravel which has to be lifted in the old way every time the eggs are removed, amounts to many tons in the course of a season.

In the new box the gravel is not lifted at all.

3d. By the old way the operator's hands must of necessity be more or less wet during the whole operation. Now as the trout and salmon spawn during the winter season, when the thermometer generally stands below the freezing point, taking eggs in the old way is not only inconvenient and painful but often impossible.

By the new way the hands are not made wet and may be kept comfortably gloved.

4th. By the old way more or less of the eggs are lost by careless feathering, exposing the eggs to the freezing atmosphere, clumsiness in handling the screens (caused by cold fingers) tipping of the screens, wash of the current, etc.

By the new way every egg is saved.

5th. By the old method every fish is driven out of the race when the eggs are taken. Some of them will not return, but will seek a spawning place in the pond and many eggs will be unavoidably lost.

By the new way the fish are not driven from the race. And as the boxes are always covered during the season, the fish will not even be disturbed. In fact they may spawn *while the eggs are being taken*, and yet not a single egg be lost.

The advantages of this method when compared with the stripping process are many. It is much less trouble to take the eggs. It is much more comfortable. It avoids handling the fish, and the consequent loss. It saves all the eggs which

are lost in the intervals of stripping. It does not disturb the fish in the process of spawning. It insures a perfectly natural impregnation.

The question whether naturally impregnated eggs are better than the stripped eggs, is not yet settled. It is certain that more eggs can be impregnated by the stripping process, but that the resulting fish are as healthy as those grown from naturally fertilized eggs, is not yet definitely proved. We are inclined to think that when the stripping is properly performed there is little difference. However this may be, a few eggs more or less are of little consequence to the trout-breeder; while convenience and speed together with certainty of result are, as in every other art, of prime importance.

REVIEWS.

Economical Entomology in Missouri.* — The annual appearance of a volume containing so much that is new † regarding the common injurious insects of a single State, is a proof that people are giving increased attention to the subject of applied entomology, and that it is considered as one of the first importance to the agricultural community as well as the country at large. There should indeed be an entomologist in each State ‡ whose sole business it should be to acquaint himself with the habits of the injurious insects, the best remedies against their attacks, and above all the habits of their insect parasites, which keep them under, as

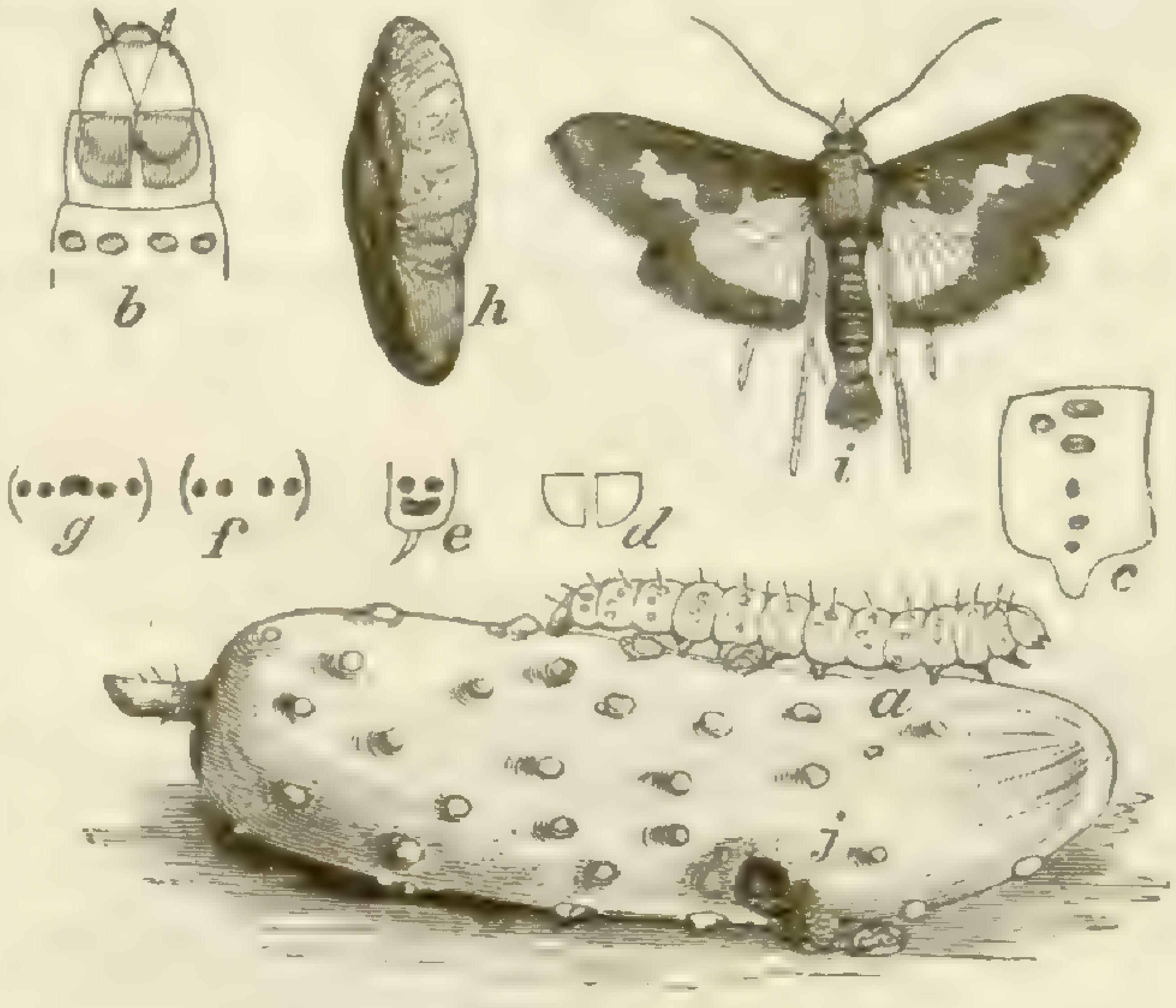
* Second Annual Report on the Noxious, Beneficial and other Insects, of the State of Missouri, made to the State Board of Agriculture. By C. V. Riley, State Entomologist. Jefferson City, 1870. 8vo, pp. 141. With numerous wood cuts. For sale at the Naturalist's Book Agency, 75 cents.

† While a large proportion of this report is reprinted from the "American Entomologist," of which Mr. Riley is the editor, yet the observations were made by him as the State Entomologist, and that able magazine may be said to be in a sense the entomological organ of the Missouri Board of Agriculture. [We regret to learn that the "American Entomologist" will be suspended for a year. We trust to see it revived at the end of that time, and meanwhile shall sorely miss its monthly visits.]

‡ Since this report was printed the State of Illinois has appointed Dr. Le Baron to succeed the late Mr. Walsh as State Entomologist of Illinois; and Dr. A. S. Packard, Jr., has been this year appointed State Entomologist, by the Board of Agriculture of the State of Massachusetts. The State of New York has published nine reports on noxious and beneficial insects by Dr. Fitch, and the State of Maine two reports, though she appointed no State Entomologist.

well as the habits of birds, which also hold them in check; and lastly, the State should liberally illustrate, print and distribute the entomologist's report. By so doing, not only would the interests of agriculture be promoted, and thousands of dollars annually saved to the State (though each legislator who unwillingly votes a thousand dollars or more may sincerely believe that he is robbing the treasury, while actually refilling it to twice that amount), but the country at large shares in the increased knowledge; and science and popular education are in no small degree promoted. The works of Dr. Harris, published by the liberality of the State of Massachusetts, are known all over Europe; in other words, throughout nearly the whole civilized world, and so are those of Dr. Fitch, the State Entomologist of New York, while the writings of Mr. Walsh, late State Entomologist of Illinois, containing so much that is novel and interesting to theoretical as well as practical entomology, are read and sought after by European authors.

Fig. 126.



Pickle Worm.

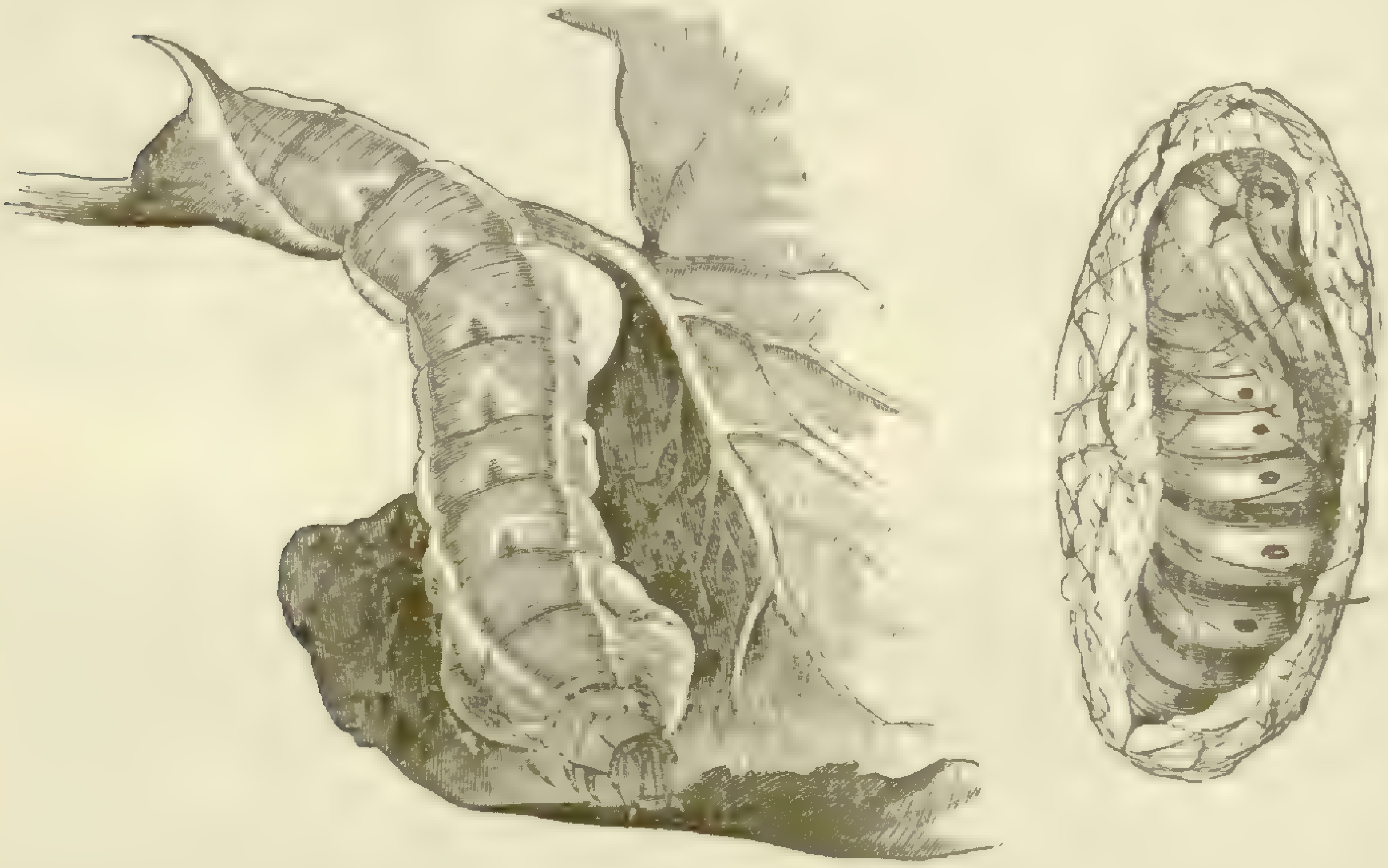
A true knowledge of practical entomology may well be said to be in its infancy, when, as is well known to agriculturists, the cultivation of wheat has almost been given up in portions of the northern states from the attacks of the wheat midge, Hessian fly, joint worm and chinch bug. "According to Dr. Shimer's estimate, which may be considered a reasonable one, in the year 1864 three-fourths of the wheat and one-half of the corn crop were destroyed by the chinch bug throughout many extensive districts, comprising almost the entire northwest. At the average annual rate of interest, according to the United States census, in the State of Illinois, the wheat crop of 1864

Fig. 127.

Vine Dresser Moth.

ought to have been about thirty millions of bushels, and the corn crop about one hundred and thirty-eight million bushels. Putting the cash value of wheat at $1.25 and that of corn at 50 cents, the cash value of the corn and wheat destroyed by this insignificant little bug, no bigger than a grain of rice, in one single State and one single year, will therefore, according to the above figures, foot up to the astounding total of OVER SEVENTY-THREE MILLIONS OF DOLLARS!" The cabbage butterfly (*Pieris rapæ*), recently introduced (p. 28) from Europe, is estimated by M. Provancher, to annually destroy two hundred and forty thousand dollars' worth of cabbages around Quebec. The Hessian fly, according to

Fig. 128.



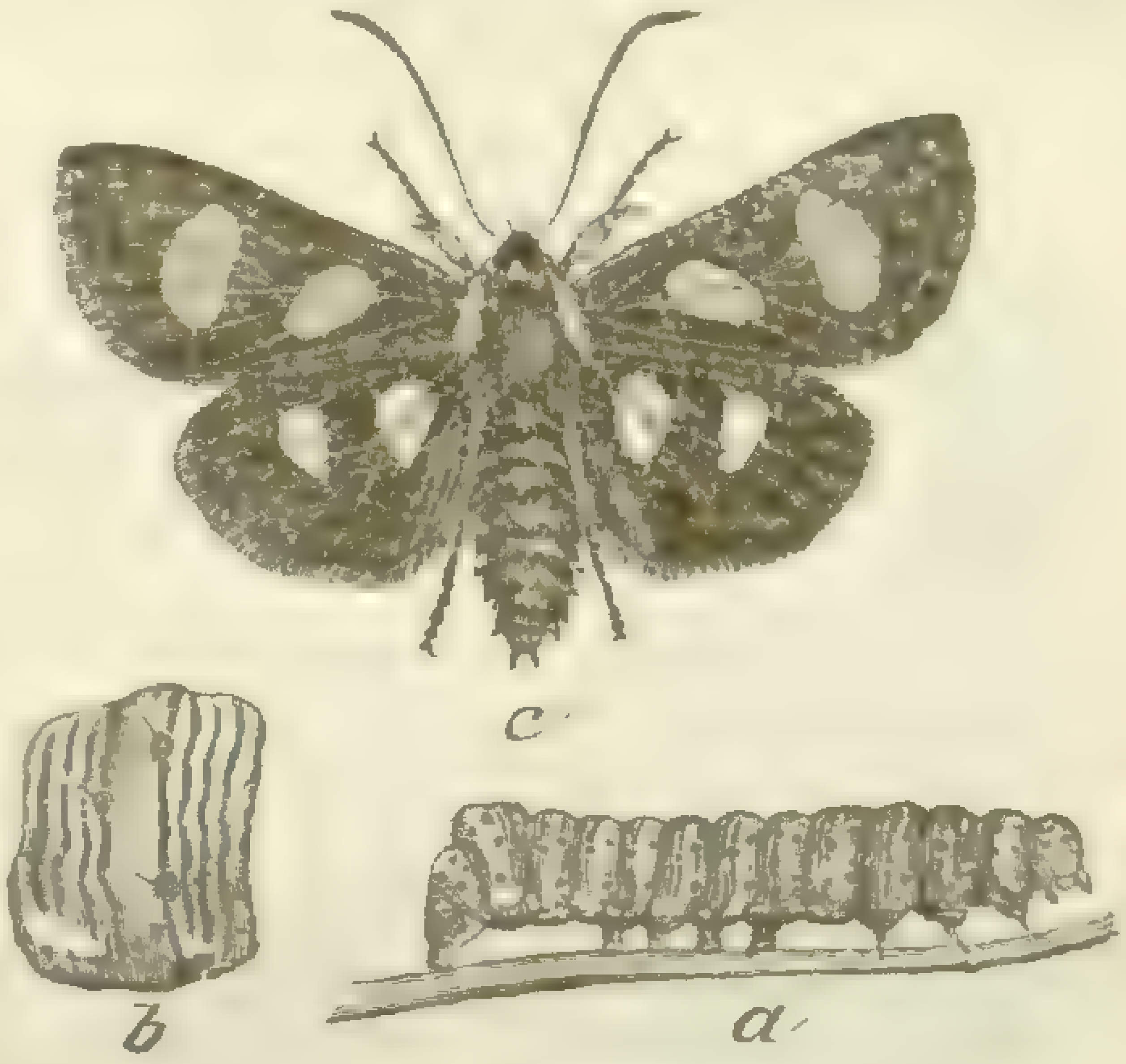
Vine Dresser and Pupa.

Dr. Fitch, destroyed fifteen million dollars worth of wheat in New York State in one year. The army worm of the North (*Leucania unipuncta*), which was so abundant in 1861 from New England to Kansas, was reported to have done damage that year in Eastern Massachusetts exceeding a half million of dollars. The joint worm alone sometimes cuts off whole fields of grain in Virginia and northward. The Colorado potato beetle is steadily moving eastward, now ravaging the fields in Indiana, and only the forethought and ingenuity in devising means of checking its attacks, resulting from a thorough study of its habits will deliver our wasted fields from its direful assaults.

Indeed the cry of waste, waste, arises all over the land. The money and material that is wasted annually in bad roads, in the loss of fertilizers from wanton waste, the loss from ignorance of geology and mining engineering, the waste involved in the process of extracting ores, the waste from bad cooking, poor housewifery, and above all, the loss of human life

from ignorance of scientific laws,* carelessness resulting from ignorance and vice, the offspring of ignorance,—the amount that is thus wasted we venture to assert would, if saved, pay off our national debt in one year, and change our world as it were into a new planet! A century hence when the country is crowded tenfold its present amount, our people will learn the lessons that science and nature teach of economy and thrift.

Fig. 129.



Alypia 8-maculata.

These remarks may be thought extravagant, but the thoughtful agriculturist, technical chemist and political economist will agree that they are true. Mr. Riley truthfully states in the introduction to his report that "we have in this country altogether more than our share of these insect depredators, and so truly is this the case, that insects which attract universal attention, and are considered as very serious evils in Europe, would not be deemed worthy of notice in this country. There, if they lose one-fifth of a given crop, the whole community becomes alarmed; but here the cultivator sometimes considers himself fortunate if he secures the half of his crop from insect ravages, and each State loses annually from fifty to sixty million dollars from this cause alone, though but four states have as yet made any attempt to prevent this serious loss." We may reasonably calculate the annual loss in our country alone from noxious animals and the lower plants, such as rust, smut and mildew, as not far from one thousand million of dollars! Of this amount at least one tenth, or one hundred million of dollars annually, could probably be saved by human exertions. Statisticians tell us that within three or four centuries the average of human life has been doubled: the average man lives forty years, where in Spencer's time he lived but twenty. The world since his time has become richer and better in proportion as the race has grown thrifty and economical in human life. So what science and knowledge has done for human life and happiness, science will do for agriculture and the arts. However chimerical our

Fig. 130.

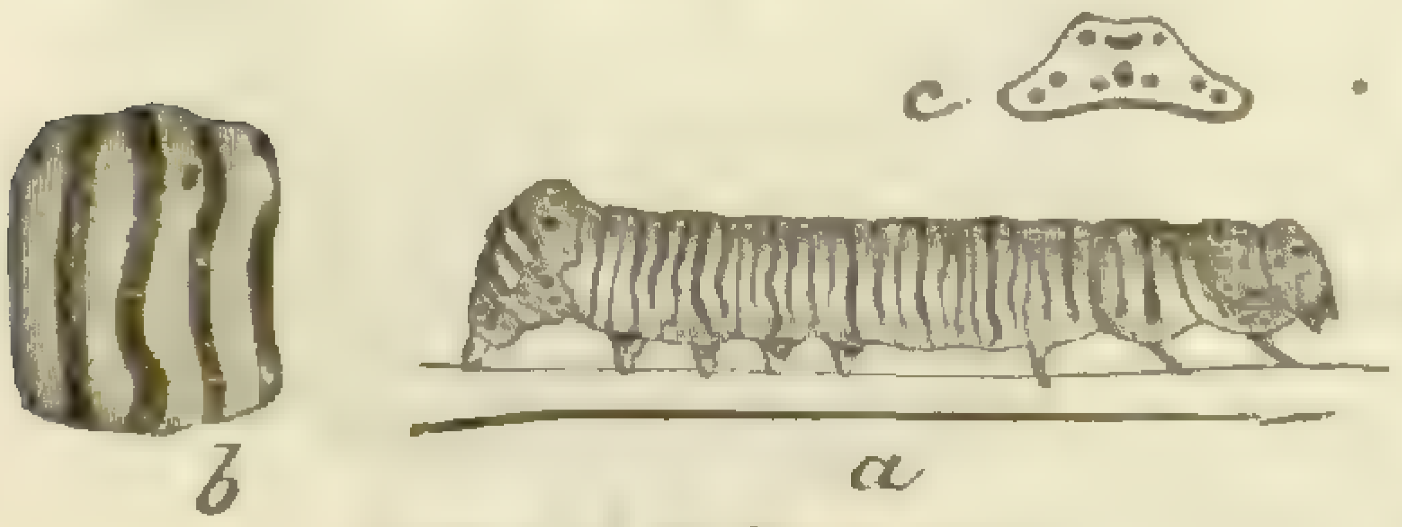
Eudryas grata.

* "In Great Britain alone more than one hundred thousand people perish annually, and at least five times as many sicken grievously, out of pure ignorance of the laws of health, which are never imparted to them at school."—*Dr. Playfair's Address at the British Social Science Congress.*

figures may appear, they at least tend to show that our material wealth and prosperity depend most intimately on the favor shown to science and the encouragement given to original research, however abstruse, by men of scientific tastes.

To save a portion of this annual loss of food stuffs and fruits should be the first object of farmers and gardeners. They eke out a bare livelihood on the present amount raised. Could they save what is wasted by insects they would grow rich; and we therefore advocate legislation for this purpose. Why should we not frame a law providing that farmers should coöperate in taking preventative measures against injurious insects, such as early or late planting of cereals, to avert the attacks of the wheat midge and Hessian fly; the burning of stubble in the autumn and spring to destroy the joint worm; the combined use of proper remedies against the canker worm, and other noxious caterpillars and cut worms? A few of the more enlightened and industrious sort are forehanded and diligent in restraining these pests. A law carried out by a proper State Entomological constabulary, if we may so designate it, would compel idle and shiftless neighbors to clear their farms and gardens. We doubt not that if each State would appoint a State Entomologist with several assistants, who should watch the fields and report neglect in killing injurious insects to the town authorities, by whom delinquents should be fined, many times the cost of maintaining such a bureau would be saved to the State. Indeed, why should we not have an Insect law, as well as Fish and Game laws?

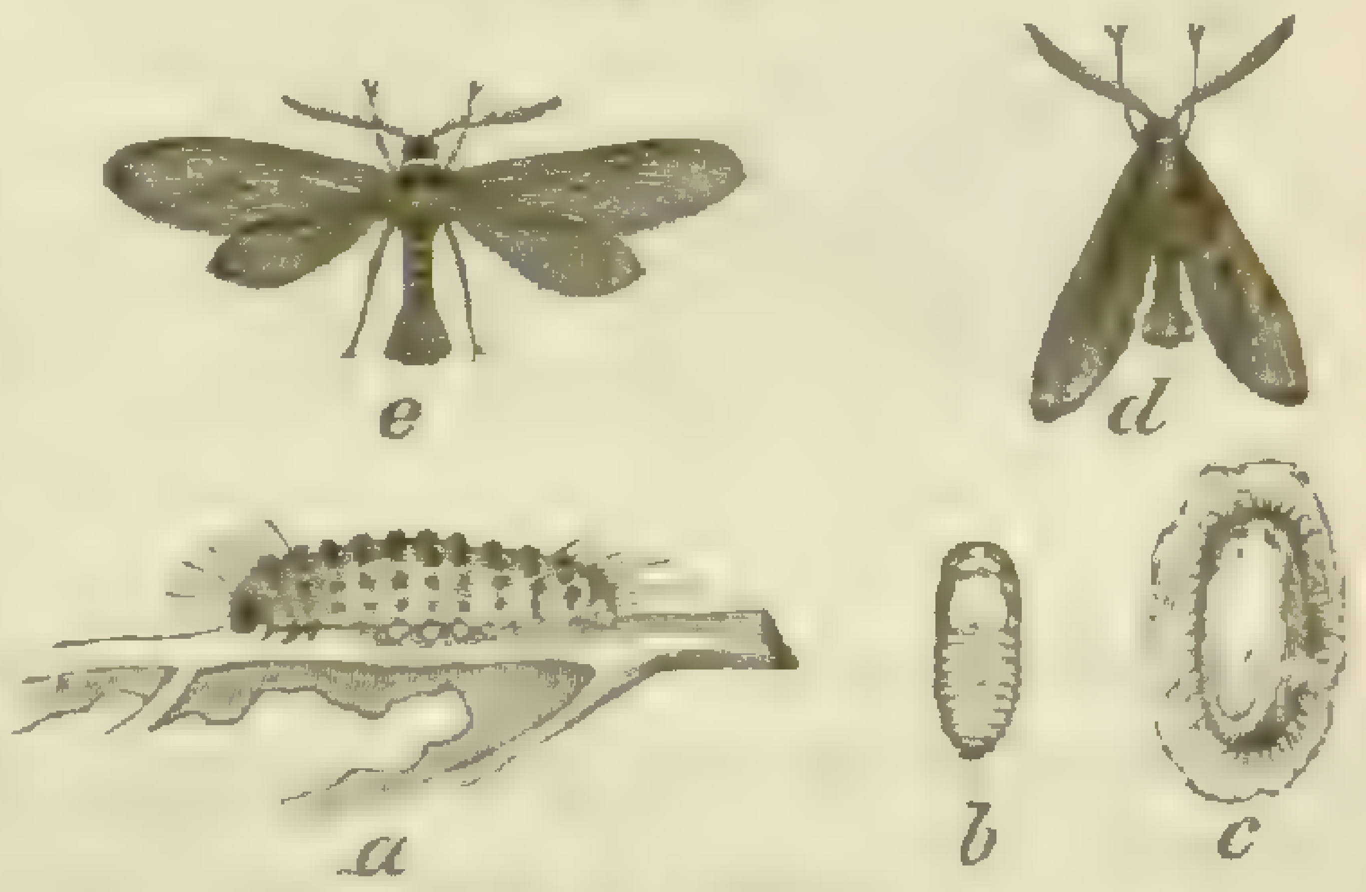
Fig. 131.



Larva of *Eudryas unio*.

Among some of the injurious insects reported on by Mr. Riley is a new pest to the cucumber in the West, the Pickle worm (*Phacellura nitidalis* Cramer, Fig. 126). This is a caterpillar which bores into the cucumbers when large enough to pickle, and it is occasionally found in pickles. Three or four worms occur sometimes in a pickle, and a single one will cause the cucumber to rot. He also gives us excellent drawings of the Vine dresser (*Chærocampa pampinatrix* Smith and Abbott, Fig. 127 larva and pupa; Fig. 128 adult;), a single caterpillar of which will sometimes "strip a small vine of its leaves in a few nights," and sometimes nips off bunches of half-grown grapes.

Fig. 132.



Acolcithus Americana.

Another caterpillar, which sometimes is so abundant as to nearly defoliate the grape vine is the *Alypia* 8-*maculata* Fabr. (Fig. 129; *a*, larva; *b*,

side view of a segment). This must not be confounded with the bluish larva of *Eudryas grata* Fabr. (Fig. 130) which differs from the Alypia caterpillar in being bluish, and in wanting the white patches on the sides of the body, and the more prominent hump on the end of the body. Another species, *E. unio* Huebner (Fig. 131 larva, *b*, side view of a segment; *c*, top view of the hump), also feeds on the grape, eating the terminal buds. It is also bluish, and wants the orange bands on the side of the body, as Mr. Riley informs us in a letter. Another moth of the same family is the American procris (*Acoloithus Americana* Clem., Fig. 132 *a*, larva; *b*, pupa; *c*, cocoon); a little dark blue moth, with a deep orange color, whose black and yellow larva is gregarious (Fig. 133) living in companies of a dozen or more and eating the softer parts of the leaves. It is quite common in the Western and Southern States.

Fig. 133.

Larva of *Acoloithus.*

There are over a hundred cuts in this pamphlet, and the mere dissemination of these illustrations will do much towards creating a taste for entomology in the young. The author sometimes admits inelegancies of expression, which mar an otherwise clear and readable style. He complains justly in his preface that the State press has used too poor ink and paper. We trust that the next report will be improved in this respect, as the excellent cuts need good, hard paper.

American Crabs.* — In this admirable paper, describing many of our North American Soldier, or Fiddler, Crabs, and their allied forms, Mr. Smith begins a series of beautifully illustrated articles "chiefly made up of notes and descriptions resulting from the study of the higher American Crustacea in the Museum of Yale College, and the collection of the Peabody Academy of Science." The descriptions seem to be carefully and conscientiously prepared. The specimen of *Gelasimus palustris*, with the large fingers (chelipeds) nearly equal in size, and mentioned as a remarkable anomaly in vol. iii, p. 557, of the Naturalist, is now referred by the author to a new species, *Gelasimus pugnax*.

* Notes on American Crustacea, No. 1. Ocypodoidea, with four lithograph plates. By Sidney I. Smith (from the Transactions of the Conn. Academy, vol. ii). 8vo, pp. 63. 1870.

THE CRAW FISH OF NORTH AMERICA.* — The Cambridge Museum has issued another of its sumptuously illustrated and printed catalogues, which the liberality of the State of Massachusetts has given it the means to do. From the hands of Dr. Hagen we have, as might be expected from his known care and accuracy in research, a monograph of much interest and value. The craw fish have been much neglected by naturalists in this country, though these fresh-water lobsters have already made their mark in the local histories of the times, by the injury they occasionally do by undermining our river dams, and especially the levee of the Mississippi near New Orleans, and the rice fields of the Southern states.

As the author refers very briefly to their burrowing habits, only alluding to the fact that a species "severely damages the rice fields of the Southern States," we would mention that according to newspaper accounts they have by tunnelling the artificial banks of the Mississippi, caused devastating floods; and while in Northern Maine we were told that the craw fish so undermined the dam at the mouth of the Aroostook River, that it was partially carried away. While craw fishes are most abundant in the Middle, Western and the Southern States, they are more common in New England than one would be led to suppose from Dr. Hagen's remarks, as he had no specimens from Maine, New Hampshire, Massachusetts, Connecticut or Rhode Island. The writer has found them frequently under stones in lakes in Northern Maine, and has had specimens from Williamstown, Mass., presented him by Mr. S. H. Scudder.

Passing over the classification and distribution of the species, we will glean some results of the author's study on the sexual peculiarities and dimorphism of these creatures. He finds that some of the females show a tendency to a more masculine development, and in some males a tendency to a feminine development. He gives a detailed account of the two sorts of males, stating that Professor Agassiz was the first to make the interesting discovery of dimorphism in the males of the genus Cambarus, to which all the species living east of the Rocky Mountains belong, while it does not occur in the genus Astacus, to which the European and Pacific coast species belong, nor in the females of either genus. The males of the first form are well developed and capable of reproduction; those of the second form are sterile, and besides certain important differences, such as the greater development of the limbs, the tarsal third of which are articulated when they are not in the males of the first form, and the "hooks on the third article of the third, or in some groups of the third and of the fourth pair of legs are smaller and less developed. The whole body has less size and width, the sculpture is not so well finished, while the claws are shorter, narrower, and more like those of the female." He adds that "the existence of a second form of the male, if it were no more than a passage or metamorphotic form, would not be ex-

* Illustrated Catalogue of the Museum of Comparative Zoology. No. III. Monograph of the North American Astacidæ. By Dr. H. A. Hagen. Cambridge, 1870. Royal 8vo, pp. 109. With eleven lithograph plates.

traordinary. But the great number of full-grown second-form specimens in every species, which are often even larger than the first-form males, seems to prove that they are individuals which have remained in a sexual stage that does not agree with their corporal development, — in short, that they are perhaps sterile." This conjecture he finds supported by an anatomical examination.

We quote all the author's general remarks on Dimorphism in Crustacea and Insects (p. 24). We have noticed in the NATURALIST, vol. iii, p. 494, iv, p. 55, the recent discoveries of Malmgren, Ehlers, Claparède and others, regarding dimorphism in the worms, which our readers would do well to read in this connection.

" *Dimorphism in other Crustacea.* — Perhaps this fact of the existence in the crustacea of two forms, one always sterile, is not unique. In the genera Lupa and Callinectes, there are not rarely females with a very narrow and acute postabdomen. These it is very easy to separate from the ordinary females, with a large and circular postabdomen. Professor L. Agassiz informs me that he has satisfied himself, by an anatomical examination of living specimens, that these females are sterile. I have found similar females with a narrower triangular abdomen in some other genera of *Brachyura*.

I am indebted to Mr. Alexander Agassiz for the information that F. Muller, Fuer Darwin, 1864, has described two forms of the male in *Orchestia Darwinii* and in *Tanais dubius*. He remarks that when found upon the shore the form of the second pair of gnathopoda varies from that of the specimens found at a distance inland, where it lives under mouldy leaves in loose earth. In *O. Darwinii*, intermediate forms between the males with large and those with small hands, are not to be detected, but in two other species, *O. tucurauna* and *O. tucuratinga*, the shape of the antennæ and of the hands changes even in the full-grown males.

The supposition that the first-born males only in *Cambarus* possess large hands for burrowing purposes is to be rejected, as the females also have the same burrowing habits.

The existence of two different forms of males in *Cambarus* is very important in the description of the species, and the fact that these forms are not recognized by all preceding authors may explain some erroneous determinations in their works."

"*Dimorphism in Insects.* — The discovery of a dimorphism in the crustacea is all the more interesting, since as yet in the whole animal kingdom dimorphism was known only in the insects. There are many facts and communications scattered through entomological literature, of which a general review is very desirable. An anatomical examination of these dimorphic forms is still wanting, only the external differences having thus far been marked.

The dimorphism seems to be represented in two different ways; a difference only in the colors (dichroic forms of Brauer), or a difference in size and shape, and mostly in the female. I should remark that dimorphism, as observed in insects, occurs only in one sex of the same species, and mostly in the female. Perhaps in the ants and in the white ants — it seems more natural to range all the socially living insects, viz., the ants, bees, wasps, and white ants under the same law — a dimorphism is to be found in both sexes.

Dimorphism consisting in different colors was long since observed, especially in Lepidoptera, in the hind wings of many Orthoptera, and in the females of Agrion. In the latter genus the well-known orange-colored females are probably sterile.

Dimorphism with difference in shape and size is also often observed. A very common case is the difference in the development of the wings. The wings are either long and well-developed, or short, or entirely wanting. The short-winged Orthoptera (Gryllus, Locusta, Blatta, Perla, Termes, Psocus) have been carefully described by Messrs. Fischer, Von Siebold, Lucas, Brauer, and myself; the short-winged or apterous Hemiptera, by Westwood and Uhler (Amphibiocorisiæ, Gerridæ, etc.); the short-winged Diptera by Schaum (*Ornithobia* and *Lipoptera*). Mr. Brauer has recently given an interesting paper upon dimorphism in the genus Neurothemis, which belongs to the Odonata. The dimorphic females have wings with a less complicated neuration and different colors. There is even a case of trimorphism in some butterflies, according to the observations of Mr. Wallace. *Papilio Ormenus*, from Celebes, has three distinct forms of females, and in some cases the number of female forms appears to be four. Dimorphism consisting in different shape and size is observed in the Lepidoptera (Equites, etc.), in the Coleoptera, in the Lamellicornia, and in the Longicornia, and perhaps

in the Lymexylon and Hylecœtus; in the Hymenoptera (Cynips); in the Diptera (Phasia). The dimorphism in the Dipterous genus Phasia, discovered by Loew, is very remarkable. Having seen his specimens, I may be permitted to add here a written communication by Mr. Loew, sent to me some years ago and still unpublished: "In the genus Phasia every species has two male forms; one similar to the female, and another much larger, with the wings broader and more colored, and usually the body more colored. The two forms fly at the same time and unite with the same form of females. The genital parts of the larger males are in shape and size identical with those of the smaller males. There exist some intermediate forms of males, and it is sometimes, in certain species, possible to form a complete series, which seems to unite the two different forms. I say seems, because I have never seen a male which I hesitated to place in one of the two forms."

I have noticed here the occurrence of dimorphism in the insects to show how variable in the different families and genera is the mode of dimorphism, even from that observed in the Astacidæ. Perhaps a closer examination will disclose even some difference in the sexual parts in certain dimorphic insects, and it now seems probable that some forms, heretofore described as distinct species, will be hereafter recognized as only dimorphic variations. Still, it is possible that very different facts are to-day united under the same name of dimorphism.

Certainly the discovery of a dimorphism in another part of the Articulata, viz., in the Crustacea, leads us to suppose that it will be found also among the worms.

THE LIFTED AND SUBSIDED ROCKS OF AMERICA.* — The author's name is well known from his admirable paintings and portraits of Indian life and physiognomy. Catlin's "North American Indians," was one of the wonder books of our childhood and youth, sharing the interest of Irving's Astoria, Cooper's Leather Stocking Tales, and Tanner's Narrative, those manuals of Indian craft and hunters' cunning that every boy delights in reading; and leading them all in careful detail, and distinguished from all in rich, pictorial embellishment.

We turn with a degree of sadness to the present little volume, and wonder how the author could have brought himself to publish such scientific nonsense. The author has been a great traveller over the American Continent, on both hemispheres. He has studied the faces and habits of the various savage tribes he met, and from his frequent references, has evidently read the works of Dana, Lyell, and other geologists, and yet here is the result of his orographical and anthropological lucubrations. To explain the formation of mountain chains he supposes that they are due to the rush of great masses of water in the crust of the earth. He accounts for the Gulf-stream by a subterranean stream under the Rocky mountains, many times larger and twice as long as the Mississippi, which together met a similar one from under the Andes. The three "debouch unseen into the Caribbean Sea and the Gulf of Mexico;" and undermine the Antilles, in the author's glowing words "a part (and probably the glory) of the Andes," which went down in the commotion of floods and volcanoes, the floods moving northwards and thus forming the Gulf-stream. Such a "cataclysm of the Antilles," naturally disturbed the minds of the people dwelling in the Quitos and Cotopaxis of the then Antilles. Our author gravely proceeds to tell us how the unhappy race became distributed northwards, and our quotation will give a fair idea of the author's capacity for dealing with such subjects. "In the turmoil and flood of the elevated waters, the Gulf-stream first bursting out of the sunken Gulf of

*By George Catlin. London, Trubner & Co. 1870. 12mo, pp. 228.

Mexico, and travelling at a pace which modern days have seen nothing of, swept off the *débris* of sinking and dying humanity in their canoes and on rafts, from the smoking chaos in which they were left, landing them on the coasts of Florida, Newfoundland, and perhaps (which would have been as probable) on the coasts of Scandinavia and Ireland." * * * "Throwing out, as it were, by explosion, the shattered fragments of [Aztec] primitive civilization to the savage nations of the globe."

In Appendix C, Mr. Catlin, with reason, protests against the discredit thrown on his statements regarding the Mandan religious ceremonies, by Mr. Schoolcraft, and memorializes Congress for simple justice, by ordering copies of his *O-kee-pa*, (published by Messrs. Trübner & Co.) to be distributed to the same libraries as Schoolcraft's work, which was evidently plundered from Catlin. We would suggest that Mr. Catlin has nothing to fear from Schoolcraft's heterogeneous and illy digested volumes, which do no credit to the Congress that ordered their publication.

GEOLOGICAL SURVEY OF NEW HAMPSHIRE.* — By his annual report we should judge that Professor Hitchcock was pushing on the work of the survey with diligence and success. Much attention has been paid to that indispensable means of geological research, a good topographical map, and Mr. G. L. Vose, one of the assistants, has "taken a large number of observations for the purpose of fixing the exact position of as many of the high mountain peaks as possible." "He has also taken accurate sketches of the outlines of all the mountains in the horizon as seen from Chocorua and Kearsarge." He also describes Mt. Carrigain, one of the least known of the White Mountains, and one most desirable to visit, for the grandeur of its notch. Mr. J. A. Huntington has made a preliminary exploration of about six hundred and seventy square miles in the north part of Coös County, and besides gives an account of his winter's occupation of the summit of Mount Moosilauke.

AMERICAN JOURNAL OF SCIENCE AND ARTS.† — This long established journal — which has from its commencement been the leading vehicle for the original papers of American scientists — will be continued after the close of the present year, AS A MONTHLY JOURNAL. This increased frequency of publication will meet a wish often expressed by authors, for a more rapid interchange of views, and an earlier knowledge of the progress of research. We hope that the friends and patrons of science will aid in promoting its wider circulation.

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* Second Annual Report upon the Geology and Mineralogy of the State of New Hampshire. By C. H. Hitchcock. 1870. 8vo, pp. 37. With a geological map.

† Founded by Professor SILLIMAN, in 1818, and now numbering 100 volumes, in two Series of 50 volumes each.

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The Chemical History of the Six Days of Creation.* — In making another attempt to reconcile Geology and Genesis, the author has exhibited much more knowledge, fairness, and a truly scientific spirit than usual in such productions. He has not drawn the parallel too closely between the chapters of Geological history and the first chapter of Genesis, and his method of treatment and interpretation of the general statements of the Scriptures, clothed as they often are, in the peculiarly rhetorical style of the languages of the East, and most difficult to translate, will command the assent of fair minded scientists and theologians. The bigoted of both classes of minds will perhaps disagree with his conclusions. He explains by the recent discoveries regarding the correlation of forces, the probable mode of evolution of the globe out of the gaseous and vaporous elements. He contends that the "nebular hypothesis and the development hypothesis may both be true, and God still remain the Creator of the Universe." A scriptural day of the Hebrew writer with our author, "is simply an evening and a morning — a period of darkness and a period of light, and the *duration* of such a day is not at all limited by anything contained in the text." He shows that the introduction of plants and the lower animals, and of fixed time, and the introduction of the higher vertebrates, and man himself, are mentioned in the same order in Genesis as in geological history, and that there is no fundamental disagreement between the Hebrew cosmogony and the facts of modern science. With this general comparison the author is content to stop.

NATURAL HISTORY MISCELLANY.

ZOOLOGY.

The Caudal Styles of Insects Sense Organs, *i. e.* Abdominal Antennæ. — Dr. Anton Dohrn has published a note in the "Journal of the Entomological Society of Stettin" (1869), to the effect that the abdominal appendages of the female of the Mole Cricket (Gryllotalpa) are true sensory organs (tastorgane).

In the "Proceedings" of the Boston Society of Natural History, May, 1866, the writer states that "while, as we have shown above, the genital armor of insects is not homologous with the limbs, there are, however, true jointed appendages attached to the ninth or tenth abdominal rings, or both, which are often antenniform, and serve as sensorio-genital organs in most [many] Neuroptera and Orthoptera" (p. 290).

In the same "Proceedings" for Feb. 26, 1868, he thus writes: "Regarding the insect as consisting of two fore and hind halves, the two ends being, with this view, repetitions of each other, these anal stylets

*By John Phin. New York, American News Co. 1870. 12mo, pp. 95.

may be considered as abdominal antennæ, so that the antennæ look one way, and their homologues, the many-jointed antenniform anal stylets, the opposite." (p. 398.)

The subject is also referred to in the "Guide to the Study of Insects," page 17, and the remarkable antenniform abdominal appendages of *Mantis tessellata* figured in illustration.

I have been able to detect sense-organs (probably endowed with the sense of smell) in the short, stout-jointed, anal stylets of the Cockroach (*Periplaneta Americana*), beautifully mounted by Mr. E. Bicknell. I have recently, after reading Dr. Dohrn's note, observed the sense-organs and counted about ninety * minute orifices on each stylet, which are probably smelling or auditory organs, such as are described by Hicks (see "Guide," p. 26). They were much larger and much more numerous than similar orifices in the antennæ of the same insect, and were situated in single rows on the upper side of each joint of the stylets. During the breeding season a peculiar odor is perhaps emitted by the female, as in vertebrate animals, and it is probable that these caudal appendages are endowed with the sense of smell, rather than of hearing, that the male may smell its way to its partner. This is an argument that the broadly pectinated antennæ of many moths are endowed rather with the sense of smelling than hearing, to enable the males to smell out the females. I have observed the same organs in the lamella of the antennæ of the carrion beetles, which undoubtedly depend more on the sense of smell than that of touch or hearing to find stinking carcasses in which to place their eggs. — A. S. Packard, Jr., *June* 20, 1870.

A Remarkable Myriapod.—While looking over a chip with Myriapods and Poduras on the under side, brought in from the Museum grounds by Mr. C. A. Walker, I detected a lively little yellowish white creature, which immediately suggested Sir John Lubbock's Pauropus, to which we have alluded on p. 45, vol. iii, of the Naturalist (where the six-legged young is figured). A closer examination shows that it is indeed a species of Pauropus, very closely allied to *P. pedunculatus* Lubbock, and intermediate in some respects between that species and *P. Huxleyi* Lubbock. It may be called *Pauropus Lubbockii*, in honor of the original discoverer of this remarkable type of Myriapods. No more interesting articulate has been discovered for many years, and the occurrence of a species in America is worthy of note. It has but nine pairs of legs (three pairs when hatched), and in some points in its organization seems to be a connecting link between the Myriapods and Poduridæ, which are true insects, probably degraded Neuroptera. Our species is yellowish white, and .03 of an inch in length. Mr. Walker assures me, after seeing this specimen, that he saw a similar one last May under the bark of an apple-tree in Chelsea, Mass. — A. S. Packard, Jr., *November* 10.

* Mr. Bicknell has counte more carefully than I did the exact number of these pits, and made out ninety-five on one stylet and one hundred and two on the other, adding, "there were none on the under side of their appendages that I could see."

WISCONSIN ACADEMY OF SCIENCES, ARTS AND LETTERS. — The first meeting of this new society was held July 19th, at Madison, Wisconsin. The president, Dr. J. W. Hoyt, reported the preparation and publication of the first number of the Academy's "Bulletin." It was also stated that a bill had passed the Legislature for a topographical survey of the lead region of the State under the direction of the Academy. A paper was read on the "Classification of the Sciences," by Rev. A. O. Wright. Mr. Englemann and Judge Knapp spoke on the destruction of the forest trees, the latter concluding that the pine forests of Michigan and Wisconsin would be wholly destroyed in twenty-five years, if their present reckless destruction continued. Judge Knapp also read a paper on "The Coniferæ of the Rocky Mountains." Mr. Murich, State Commissioner for the survey of the lead region, read a paper on "Mineral Veins and the Origin of the Potsdam sandstone." Dr. P. R. Hoy gave an account of recent studies on the fish of Lake Michigan, and of the recent dredgings in the lake in connection with Drs. Thompson and Lapham, published in the present number of the NATURALIST. Other papers were read.

We have also to note the existence of a flourishing Natural History Society in Milwaukee, Wisconsin.

HOW TO MOUNT SPIDERS FOR CABINETS. — In M. Thorell's fine 4to on European Spiders, which singularly enough, is published in Upsala, and yet printed in the English language, the following instructions are given: — "The spider is first killed, either by the vapor of ether or by heat, and is impaled by an insect-pin, which is passed through the right side of the cephalothorax; the abdomen is then cut off close to the cephalothorax, and the cut surface dried with blotting-paper. The head of another insect-pin is cut off, and the blunt extremity introduced through the incision into the abdomen, up to the spinners. The abdomen thus spitted is inserted into a large test-tube held over the flame of a candle, the preparation being constantly rotated till dry, avoiding the extremes of too much or too little heat — the firmness of the abdomen being tested every now and then with a fine needle, till it is so firm as not to yield to pressure; the front extremity of the pin is now cut off obliquely, and the point thus made inserted into the cephalothorax, the two halves of the body being thus again brought into apposition. The animal may then be mounted as usual." — *Popular Science Review.*

THE TOUCAN'S BEAK. — Permit a few words in answer to the question "Wherefore such a beak" for the Toucan. On page 306. of that most lively and interesting book for a denizen *pro tem.*, or longer, of the tropics "The Andes and the Amazon," by Professor J. Orton, the author has a rather piquant discussion of this question. I answer it by saying, to *feed with*, to be sure. What else? Perhaps also for defence and pluming. But how he could part his back hair feathers, like a dandy, does not appear. His method of feeding explains the whole riddle of his long, heavy, serrated mandibles. Like the shovel-nosed tribe, or the digger-

like tribe, or the curved-beak tribe, shape, form, size, is everything for their peculiar method of obtaining rations.

The Toucan feeds on insects, which lie deep in the corolla of flowers; it especially delights in tubular corollas, and has a great fondness for the rich, scarlet, fuschia-like clusters of the Rose de Monta, of Guayana. These clusters he seizes near the calyx, and by longitudinal movements of his powerful mandibles, aided by their serrated edges, saws them off, and then by his horny and fimbriated tongue, separates the insect portion from the vegetable, and swallows that which his palate approves of, like any other sensible bird. To see him hop from branch to branch, reach out his long, ponderous jaws, seize his breakfast, saw it off, as one sees a butcher in his stall, to see the parts rejected fall to the ground in petaliferous showers, and he maintain his equipoise, has been one of the most pleasant studies of my ornithological curriculum. I have made frequent post mortem examinations of his injestæ, and have always found the shields and remains of insects the most abundant in his craw. — R. P. Stevens.

Physella not a Fresh-water Shell. — Mr. Tryon called the attention of the Conchological section of the Philadelphia Academy of Natural Sciences, to the curious error committed by several conchologists in treating *Berendtia* (*Physella*) *Berendtii*, as a fluviatile mollusk. He supposed that the resemblance of the first generic name given to Physa was the cause of the error. This Mexican snail has a Glandiniform shell and Mr. Tryon believed that its true position would be found to be near to Glandina. The *Physella* has been included as a fluviatile mollusk in Mr. Binney's monograph, recently published by the Smithsonian Institution, and still more recently in Mr. Dall's Classification of the Limnæidæ, published in the "Annals of the New York Lyceum of Natural History. Mr. Tryon also made some remarks upon the Darwinian Theory of the origin of species as illustrated by the "groups" or subgenera of Helices, established by Albers, and stated his conviction that nowhere in the animal kingdom could more conclusive evidences of the truth of Darwinianism be adduced.

GEOLOGY.

Did a Glacier flow from Lake Huron into Lake Erie? I find on page 193, of Vol. 4 of the American Naturalist, an article by Professor J. S. Newberry, on "The surface Geology of the basin of the great lakes and the valley of the Mississippi," which I wish to criticise as to the position taken by the Professor, that formerly a glacier flowed from Lake Huron into Lake Erie. On page 195 the Professor states that "Lake Michigan, Lake Huron, Lake Erie, and Lake Ontario, are basins excavated in undisturbed sedimentary rocks. Of these, Lake Michigan is six hundred feet deep, with a surface level of five hundred and seventy-eight feet above tides; Lake Huron is five hundred feet deep, with a surface

level of five hundred and seventy-four feet; Lake Erie is two hundred and four feet deep, with a surface level of five hundred and sixty-five feet; Lake Ontario is four hundred and fifty feet deep, with a surface level of two hundred and thirty-four feet above the sea." "An old, excavated, now filled channel, connects Lake Erie and Lake Huron." And on page 200 the Professor states as his deduction, "2d. That the courses of these ancient glaciers corresponded in a general way with the present channels of drainage. The direction of the glacial furrows proves that one of these ice rivers flowed from Lake Huron, along a channel now filled with drift, and known to be at least one hundred and fifty feet deep, into Lake Erie, which was then not a lake, but an excavated valley, into which the streams of Northern Ohio flowed, one hundred feet or more below the present lake level." It will be granted, no doubt, that a glacier occupies the bed, or lowest part of the valley through which it flows, and, that like water, it flows from a higher to a lower point of elevation, or in other words, that it flows down hill, instead of up hill. But if Professor Newberry's position, that formerly a glacier flowed from Lake Huron into Lake Erie, be correct, then it must, in passing from the bed of Lake Huron into that of Lake Erie, have ascended a vertical height of two hundred and seventy-eight feet, for from the Professor's own showing the bed of Lake Erie is that number of feet above that of Lake Huron; for he states that the surface of Lake Huron is five hundred and seventy-four feet above the sea level, and that it is five hundred feet deep, which would make its bed seventy-four feet above the sea level; and he further states that the surface of Lake Erie is five hundred and sixty-five feet above the sea level and is two hundred and four feet deep, which locates its bed at three hundred and sixty-one feet above the sea level, and two hundred and eighty-seven feet above that of Lake Huron. If it be true, which is granted, as stated, that "an old, excavated, now filled channel connects Lake Erie and Lake Huron, then must it also be true, granting that the beds of these lakes occupied the same relative position to each other in the glacial period that they now do, that whatever glaciers flowed through it must have flowed from Lake Erie in the direction of Lake Huron, and found an outlet in that direction, instead of from "near the eastern extremity of Lake Erie into Lake Ontario; otherwise we shall have the phenomenon of a column of ice two hundred and fifty miles in length, by about twenty-five miles in width, saying nothing as to its thickness, lifting itself, by the mere force of gravity, from a lower up to a higher plane of elevation, which would appear to be impossible. The probabilities are that the furrows in the "old, excavated, now filled channel, connecting Lakes Erie and Huron," were made by running or floating icebergs, long ages after the work of excavating the beds of the great lakes by the glaciers had been completed, and not by true glacial ice. The difficulty of reconciling the observed facts in the case, seems to accrue from allotting too short a space of time to the glacial period. It would appear more perspicuous to allow an excavating period, corres-

ponding in time with the period of the greatest continental elevation, during which period the glaciers would naturally flow in the direction of the lowest plane of their excavations, finding their outlets accordingly. The work of excavation being completed, then comes a continental subsidence, the "lower drift period," during which the narrower channels of excavation are completely filled, and the larger ones partially. Then comes another continental elevation, not so great, however, as the first; this is the "old channel" period, during which the great lakes take form as such for the first time, and all those "old drift channels" were excavated by running water and floating icebergs. Then comes another continental subsidence, much greater than the first or "lower drift period;" this is the upper drift period, during which those "old channels" are completely filled, and the surface elevated above them from one to two hundred feet, and even more. Then comes another continental elevation, the beginning of the present status of appearances. — L. J. STROOP, *Waxahachie, Ellis County, Texas.*

MICROSCOPY.

AMERICAN MICROSCOPES. — The able refutation by your correspondent, C. S., in your issue of September, of the statements made by Dr. Hagen, with respect to American microscopes, cannot but have been read with gratification by all interested in the question. It is a fact much to be deplored, that in scientific questions — of all others — national vanity and prejudices should so far warp the judgment of otherwise very competent writers, as to drive them to the most obviously, to use Dr. Hagen's own mild epithet, "comical" conclusions.

Referring to German stands, for whose glorification Dr. Hagen seems to have written the papers in question, any one who, like myself, has had the opportunity of visiting the workshops of nearly all the most celebrated manufacturing opticians of Europe, will say that stands of continental manufacture, be they French or German, are sadly deficient in those improvements and appliances constituting a first class working English or American instrument. From this statement I except neither Mertz of Munich, nor Hartnack of Paris. Nachet, from the latter city, is the only maker whose instruments, in any way approach the perfection of either English or American stands. This deficiency in appliances and working means, in continental instruments, will be readily understood, when I mention that when I remonstrated upon the deficiency of stage motion in his best first class stands, Hartnack answered me: "Well, I see that you go for those English or American instruments looking like a steam engine, with screws, levers, and milled heads in every direction; *we do not believe in such toys here.*" As to the upright vertical model, it speaks for, or rather against itself, as anybody knows

that has ever used one of them; and still it is, to this day, the favored pattern adopted by students throughout France and Germany.

About objectives and eye pieces, I have nothing to say in addition to what C. S. has so ably discussed in his paper; unless I venture to remind Dr. Hagen that the wonderful performance of one given glass in the hands of one observer, often proves an utter failure in the hands of another, though both acknowledged "adepts" in the use of the microscope. This undisputed fact should make one very careful before pronouncing *ex cathedra* upon the merits of objectives produced by artists of unquestioned ability. In connection with this last remark, allow me to state that I shall be most happy to show to Dr. Hagen the *Surirella gemma* and its markings, which he only saw dimly with a 1-10th inch objective of Tolles; to show him, with a 1-8th inch immersion lens of W. Wales, the "basket work," as we call the elongated hexagons of that fine test at the Bailey Club, as near to Hartnack's theoretical diagram, as it is practicable to accomplish in a microscope view of that diatom. This very same 1-8th inch glass failed completely to show any markings on the *Surirella* in the hands of Hartnack, who, after having shown me the faintest display of the lines in question with his No. 11 — almost equal to the 1-15th of our makers — pronounced my poor 1-8th an "inferior glass," which, "as long as I lived, would never resolve the *Surirella gemma*." So much for hasty judgments. The determination of the abstract, as well as relative merits of objectives, must stand, in the opinion of all experienced microscopists, when one considers the many details of manipulation which cannot fail to influence their performance, as one of the most perplexing and difficult problems to settle in practical optics.

Although not having the right to claim thirty years experience in the use of the microscope, and although one of the most insignificant *dilettantis* in the realm of microscopy, I venture to bring to bear my humble testimony, and some little experience gained in long European peregrinations, in favor of the superiority of English and American instruments, for both their mechanical and optical excellence, over all continental productions in the same line, begging here to mention, that in my statements I am influenced by no national prejudices, as I do not belong by birth, to either of the two aforesaid nationalities; neither am I a member of the Boston Optical Association. — T. O., *Cornwall Landing, Sept.* 16, 1870.

WALES' LOW POWER OBJECTIVES.* — May I ask of you the favor of a few lines in reply to Mr. Bicknell's note in the NATURALIST for June last. Mr. Bicknell agrees with me in according to Mr. Wales' objectives the high rank to which they are undoubtedly entitled, but in some way seems to have overlooked what the communication was intended to set forth before the microscopic world. It was not that Mr. Wales' 4-10 had an amplification of two hundred and ten diameters, or that Mr. Wales' did or did not

* This reply, with a number of other articles, has been unavoidably postponed on account of the space devoted to the reports of the meeting of the American Association. — EDS.

underrate his lenses in the naming of them. The point really presented was, that lenses of such low power should do so much, there not being any great liability of material difference in the amplification present in objectives of such low power as 3-inch. No measurement of its power was given. Not so, however, in the case of the 4-10, for as is well known, and as Mr. Bicknell states, objectives of various makers rating the same, differ greatly in their magnifying power. And this again occurs, not only with the objectives of different makers, but even the objectives of the same maker differ, although rated the same, *e. g.* in R. & I. Beck's Catalogue, 1868, are advertised 1-4 inch objective (No. 234) magnifying power two hundred and ten, and on a succeeding page 1-4 inch objectives (No. 296) magnifying power one hundred and forty diameters. Therefore I gave the amplification used, and such being known, it would in reality be immaterial what the objective might be called. In fact the succeeding paragraph distinctly states "that with no equal power of Powell & Leland's of London, of Hartnack of Paris, of Tolles and Grunow of this country, or of Gundlach of Vienna, various objectives of each and all of which makers I have examined, have either I myself, or other microscopists of my acquaintance, been able to effect this."

I do not say with a 4-10 objective, for firstly, they all differ in their amounts of amplification, and secondly, neither Hartnack nor Gundlach thus denominate their objectives, but as usual with Continental makers, number them as 1, 2, 3, and so on. The word power, however, I thought could not be misunderstood, such equality of power being most easily attained by the use of the draw-tube.

That an objective magnifying two hundred and ten diameters when used in connection with a No. 1 or an A eye-piece, should resolve the *Pleurosigna angulatum*, mounted, not dry, but in balsam, and by direct light, instead of oblique, is what I wished to put on record, and such I think the generality of microscopists would infer on perusal of the article. As, however, Mr. Editor, Mr. Bicknell is of the opinion that I have made an error in my measurements of the amplification, and as the liability of error is less when the testimony of many witnesses are concurrent, I would state that not only have I myself remeasured the amplification present on the use of said objective in said resolution, but that I am permitted to use the names of Dr. Edward Curtis, formerly of the Army Medical Museum, Washington, D. C.; of Mr. Joseph W. Ward, the well known microscopist of this city; and of Mr. O. G. Mason, Photographer of Bellevue Hospital, names familiar to all microscopists in New York, in testimony of the correctness of said measurement.

As regards the second point raised, namely, the underrating of objectives by their various makers, it is, undoubtedly, the fact, not however I think from any intention to mislead, but rather from an inherent want or defect in the nomenclature in use. The denominating of an objective a 4-10, 1-5, 1-8 and so on, answers a certain purpose of informing us of about what power is meant, but if, in addition, the makers would engrave

upon their objectives the amplification present when the image formed by such objective is thrown upon a screen at the recognized normal distance of ten inches (or 254 millimeters) from the object we should then have something definite. The mode which I find most convenient for obtaining this amplification of the objective considered in and by itself is as follows: An image of the lines or divisions of a stage micrometer is caused to fall upon the eye-piece micrometer of the micrometer eye-piece —the collective or field glass of the same having been previously removed. The plane or distance from the stage micrometer at which the eye-piece micrometer should be placed, namely, ten inches, may easily be effected by means of the draw tube. By comparison of the lines of the stage micrometer as thus projected, with those of the eye-piece micrometer the amplification of the objective is readily determined; the eye glass of the eye-piece enlarging both sets of lines equally, and greatly facilitating the reading. In this use of the eye-piece micrometer it is necessary that the exact value of its scale should be known, a point unimportant when otherwise used. The scales upon the micrometers which I use and find in general best adapted to the purpose, are a millimetre divided into 1-100 for the stage micrometer, and a centimetre divided into 1-100 for the ocular or eye-piece micrometer.

With the highest respect and kindliest of feelings towards Mr. Bicknell, who has contributed so largely to the advancement of microscopic science in America, I intended in my original communication, not the bringing before the public the superior excellence of Mr. Wales' lenses, for of their merit in this country we are all agreed, but to place on record certain resolutions as attained by exceedingly low amplification. — J. J. HIGGINS, M. D.

THE SIMPLEST FORM OF MICRO-TELESCOPE. — At a field meeting of the Albany Institute, held in Hoosic Falls, on the 24th of September, Dr. R. H. Ward of Troy, N. Y., exhibited a simpler form of micro-telescope than has hitherto been proposed. He screws an ordinary 4-inch objective (5-8 inch wide, 2 3-4 inches solar focus) into an adapter (about 2 inches long) below the stage of the "seaside," " clinical," or any other hand-microscope. To this object-glass the compound body, with all its lenses, acts as an erecting eye-piece, as in Tolles' telescope and Curtis' micro-telescope. Of course, no one would expect from a 5-8-inch opening the light of a 1-inch opening; but the new arrangement gives a really useful field-telescope without requiring a single addition to the microscopist's apparatus. Solid (single combination) objectives act best as erectors in this case, but the ordinary objectives, from 2-inch to 1-2-inch, answer very well. The same arrangement, by raising the tube considerably, and perhaps substituting a 1-inch objective for the 4-inch, furnishes an erecting compound microscope which is excellent as a hand-magnifier for field use; and by removing the lens below the stage we have the ordinary field microscope on which the object may be placed in the " clinical compressor," or otherwise.

ANTHROPOLOGY.

The Significance of Cranial Characters in Man. — Professor John Cleland has communicated to the Royal Society a paper in which he gives an account of some careful investigations into the cranial measurements of various races, and criticises the various methods of craniometry in use — pointing out what facts of growth and relations of parts the observed measurements really indicate. He observes that if the terms dolichocephalic and brachycephalic are to retain any scientific value as applied to skulls, the "cephalic index" (that is, the breadth in terms of the length which is called one hundred) must not be depended on. Other points of importance, as pointed out by Retzius, must be attended to. According to Dr. Cleland, the relation of the height to length of a skull is of great importance. There is no foundation whatever for the supposition, which is a wide spread one, that the lower races of humanity have the forehead less developed than the more civilized nations; neither is it the case that the forehead slopes more backwards on the floor of the anterior part of the brain-case in them than it does in others. — *Quarterly Journal of Science.*

Hereditary Genius. — In his late work on "Hereditary Genius," Mr. Francis Galton thus describes his purpose:

"What I profess to prove is this: that if two children are taken, of whom one has a parent exceptionally gifted in a high degree—say as one in four thousand or as one in a million—and the other has not, the former child has enormously a greater chance of turning out to be gifted in a high degree than the other. Also, I argue that, as a new race can be obtained in animals and plants, and can be raised to so great a degree of purity that it will maintain itself, with moderate care, in preventing the more faulty members of the flock from breeding, so a race of gifted men might be obtained, under exactly similar conditions."

AMERICAN ASSOCIATION.

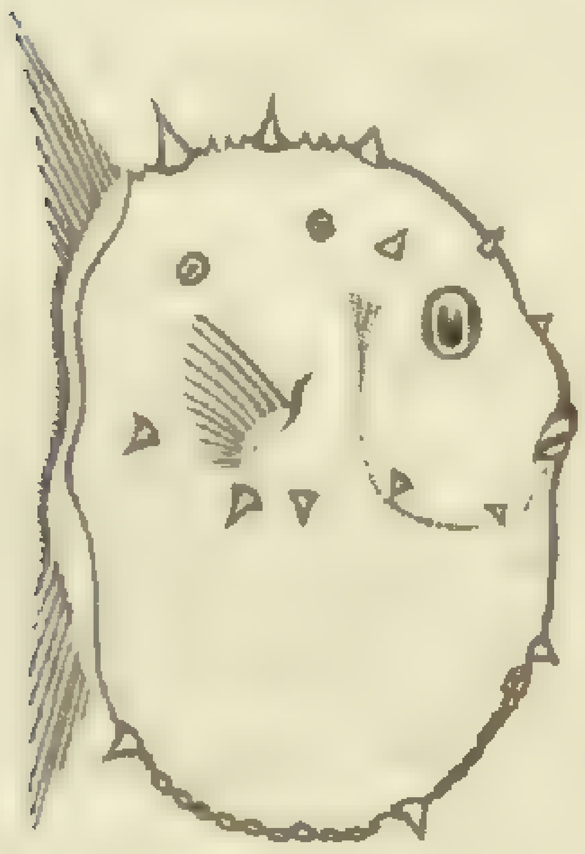
Nineteenth Meeting of the American Association for the Advancement of Science, held at Troy, N. Y., August 17th–24th. 1870. [*Abstracts of papers continued from the November Number.*]

Mr. F. W. Putnam made a communication "On the young of Orthagoriscus mola." He had been led to his investigations by the statement, made by Messrs. Lütken and Steenstrup,* that the young of Orthagoriscus differed greatly from the adult, and that Molacanthus was not a distinct genus, but simply the young state of Orthagoriscus. This statement of the distinguished Copenhagen zoologists led him to believe that they had not seen the young of Orthagoriscus and had been misled by the singular form of Molacanthus in considering that genus as the younger state of

* Œfversigt Danske Vidensk. Selsk. Forhandl. 1863. p. 36.

the sunfish. He exhibited drawings of *Molacanthus*, of the adult form of *Orthagoriscus mola* and *O. oblongus*, and of the young of the last two. The drawing of the young of *O. oblongus* was copied from Harting's work. Harting had figured the specimen in connection with remarks

Fig. 134.



Molacanthus Palassii (1-2 grown, natural size).

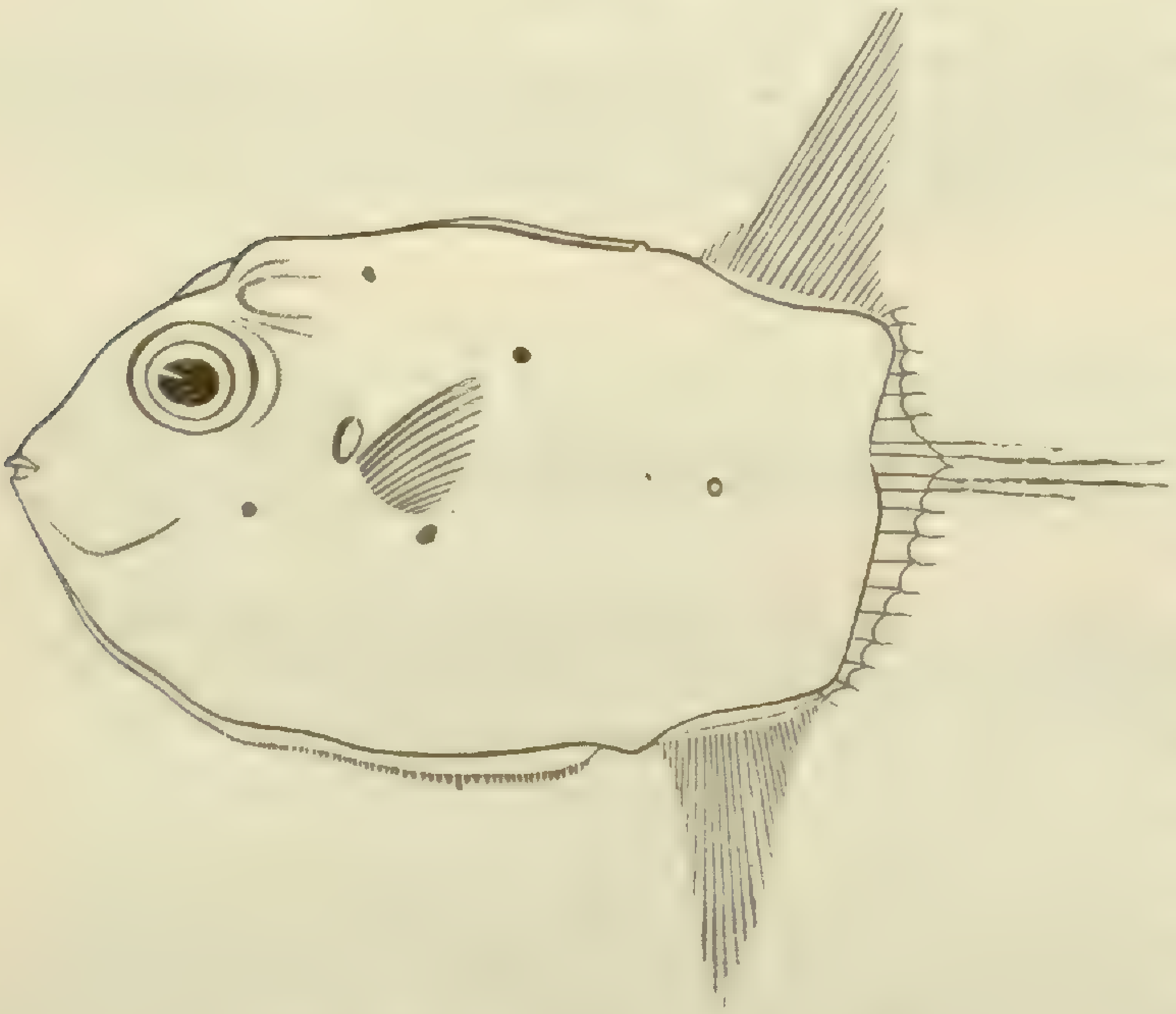
Fig. 135.

Orthagoriscus oblongus (young, natural size).

to the effect that he thought the young of this genus were not so different from the adult in form as supposed by Lütken and Steenstrup.

The drawings of the young of *O. mola* were from specimens taken in Massachusetts Bay and now in the Peabody Academy of Science, having been received from the Essex Institute in whose collection they had been for many years. These specimens, four in number, were about two inches in length, and while differing from the adult in several particulars were yet so near to the adult form in all their important features that no doubt could be entertained as to their being the young of *O. mola*. In these young specimens the eye is proportionally very large, and is placed at the margin of the head, while in the adult it is situated some distance from the margin. In the young the dorsal fin and the upper portion of the caudal

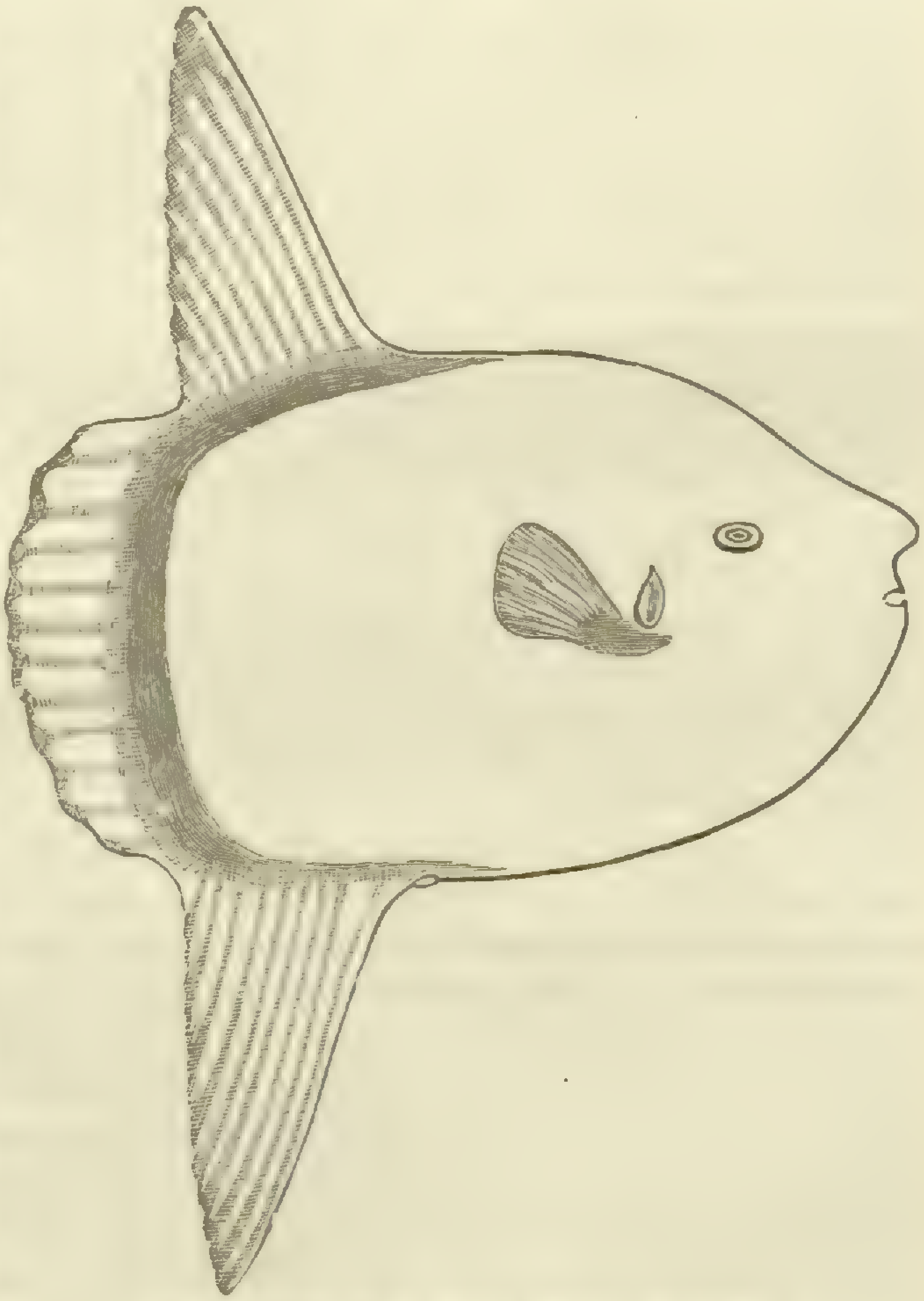
Fig. 136.



Orthagoriscus mola (young, natural size).

are thrown respectively a little backward of the anal fin and the lower part of the caudal. By following out a series of drawings, taken from specimens of various sizes, he showed how the growth of these fishes was more rapid in their dorsal and anterior parts than in other portions of the body, and that from the pushing forward of the posterior parts, and the tendency to develop a large head at the expense of the body, which culminated in the formation of the projecting "nose" so characteristic of the old specimens, he was led to the conclusion that the various forms of the short sunfishes were all of one species, and those of the oblong type of another; these two forms probably representing two distinct genera of one species each (perhaps two of the *mola* type).

Fig. 137.



Orthagoriscus mola (adult, greatly reduced).

In the young *O. mola* the caudal fin is composed of eight rays in its upper half and eleven rays in its lower half. These rays are elongated filaments, and by their regular increase in length as they approached the centre of the fin the caudal became a pointed fin. Along the ventral portion of these young fishes is a fleshy ridge, easily detached from the body, and armed with several rows of small spines. The back, for about half the distance in front of the dorsal fin, has a slightly raised fleshy ridge.

Several interesting points were mentioned in connection with the skeleton of the young and the changes which take place in its growth. The neural spines of the 5th to the 15th vertebræ are closely packed together with the interneural spines, and extending backwards support

the dorsal fin, while the hæmal spines of the 10th to 16th vertebræ are in close connection with the expanded interhæmal spines supporting the anal fin. The 16th vertebra gives off large neural and hæmal spines, the former having five interneural spines anchylosed with it as in the adult, while the hæmal spine supports nine interhæmal spines, the lower one of which belongs to the anal fin while the others are of the caudal chain. In the adult only seven interhæmal spines are connected with this hæmal spine. The 17th vertebra in the adult lies in the caudal chain of interspinous bones and, from its being separated from the vertebral column, has been as often considered as an interspinous bone as a vertebra. In the young specimens this vertebra, though separated from the column as in the adult, has in close connection with it two bones above and two below, probably indicating that this vertebra is in reality the consolidation of two vertebral bodies, the 17th and 18th, while two other small (neural and hæmal) bones posterior to this free vertebra indicate that a 19th vertebra existed at an earlier stage. These six neural and hæmal (three each) bones disappear in the adult, and with them the central rays of the caudal fin, and they and the 17th, 18th, and 19th vertebræ are only represented by the free or "floating" 17th vertebra which lies in the chain of interspinous bones of the caudal. This is the only instance of a vertebra existing as distinctly separated from the vertebral column known to the author.

A dissection of the soft parts of the young shows the same arrangement as in the adult; the large liver extending in two lobes and enclosing the stomach and portions of the intestine, and the long intestine with its five or six folds. The arrangement of the bundles of muscles is the same as in the adult.

On comparing these young with Molacanthus an entirely different structure is observed. First, the external form of Molacanthus differs greatly from Orthagoriscus; the body is deeper than long in Molacanthus, while the reverse is the case in Orthagoriscus. There are many largely developed spines on the former, and the skin is thin, silvery and smooth between the spines. In the latter the skin is thick, the anterior portion is protected by small granulations and the rest is covered with fine villous scales; there are five singular naked spaces on each side, three of which have a raised granulated margin, and there is a similar raised space just in front of the dorsal fin. In Orthagoriscus the dorsal and anal are closely connected with the caudal, which, in comparison with the adult, is largely developed in the young, while in Molacanthus no caudal fin can be traced, and the dorsal and anal are separated by a naked space (though all the figures of this fish thus far published represent the dorsal and anal as united by a caudal, the row of small dermal spines at this portion having been mistaken for rays). The skeleton of Molacanthus shows the interspinous bones of the dorsal in connection with the neural spines of the 4th to 17th vertebræ, and those of the anal with the hæmal spines of the 10th to 17th vertebræ. The vertebral column in Molacanthus

terminates abruptly with the 17th vertebra, and no caudal chain of interspinous bones can be traced. The liver is small, when compared with that of the young Orthagoriscus, and is composed principally of a large right lobe overlying the stomach. The stomach is small and the intestine is short, making but two turns, like the letter S, while in Orthagoriscus it is long and has five or six turns, or coils. The arrangement of the muscles and the bones of the head are, in general, about the same as in Orthagoriscus.

Figure 134 is from a specimen of *Molacanthus Palassii*,* natural size. This specimen was taken from the stomach of a dolphin caught in the North Atlantic and belongs to the Boston Society of Natural History.

Figure 135 is the young of *Orthagoriscus* (*Cephalus*) *oblongus*, copied from Harting's Memoir. This specimen was taken from the stomach of a "Thon" caught in the Atlantic Ocean, and is represented of natural size.

Figure 136 is from one of the young specimens of *Orthagoriscus mola* taken in Massachusetts Bay. Natural size.

Figure 137 represents the adult form of *Orthagoriscus mola* from a drawing of a specimen taken in Massachusetts Bay in 1856. Length forty-two inches; width from tip of dorsal to tip of anal sixty-four inches. This specimen was fully developed and shows the characteristic "nose" of the older individuals, the backward position of the eye and the position of the fins. None of the published figures of the adult are very correct in their outline. The best is that of Harting, under the name of *Orthagoriscus ozodura*, in the Transactions of the Academy of Amsterdam for 1868. An intermediate stage between the young and the adult, here figured, is represented by the figures of Bloch, Donovan, and Yarrell.

Dr. R. H. Ward read a paper before the Section of Microscopy "On the Illumination of Binocular Microscopes." The object of this paper is not to add anything to the facilities at the command of specialists in microscopy, whose devotion to narrow branches of study, often accompanied by ample means to command every assistance within the skill of the opticians, has brought into existence the sumptuous first-class stands and their elaborate accessories, but to make some suggestions in the interest of that larger class, microscopical amateurs, who, incidentally to other occupations, use the instrument for the general study of natural history. Such persons usually, and wisely, buy the smaller instruments of the market, and their choice of apparatus, and consequent success in work, depends much upon the chances of trade and the interested partiality of dealers.

It is not strange, but unfortunate, that this class of apparatus, students'

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*The synonymy of these fish will be discussed in full in the Memoirs of the Academy. The names now used are those under which the species are most generally known.

Mr. Putnam's paper will be published in full in a future number of the Memoirs of the Peabody Academy of Science, with several plates, illustrating more fully the points mentioned in this abstract.

microscopes, *et id omne genus*, should latest and least feel the control of real science in their construction. Only a few years ago in London, and much later in this country, was there any serious effort to make students' microscopes worthy of the times. Even now some of the best of these are sold without a diaphragm below the stage, or with so small a body that the lowest (and, for beginners, best) eye-piece gives a ridiculously small field, and too many are still built upon the old vertical plan which has been obsolete for twenty years. In regard to stereoscopic microscopes the case is still worse. Tolles' binocular eye-piece "for microscopes only" is not yet in the market, though expected for years, and Wenham's binocular, long since popularized in England, is nearly unknown here except on large and costly instruments. Grunow, of New York, has done something during past years to furnish small binocular instruments. When will he, and Tolles, and Zentmayer, and Miller, and McAllister, and others, do for us what Crouch, and Collins, and Murray and Heath, and Beck, and many others, have long since done for England in supplying an abundant variety of good binoculars of moderate size and cost? If the binocular microscope were unnecessary for anybody it would be for the diatomist; yet I can scarcely believe that such a person, after seeing a Möller's type plate properly illuminated under a 4-10 objective of 110° or 120° in a good binocular, would ever advise any person to purchase a monocular instrument except as a necessity of price. While we are waiting for still further improvements in the binocular, promise of which may be seen in Mr. Holmes' bisected lens, the erecting binocular of Mr. Stephenson, and the binocular by double refraction of Dr. Barnard, let the contrivances already available, Wenham's for low and medium powers, and Tolles' for high powers, be made to do all the good they can do.

We should take care that in simplifying our apparatus we do not gain simplicity at the expense of convenience. Of the three elements in microscopical work, the object, the amplifiers, and the light, the latter is the most difficult to handle and is least satisfactorily provided for. If any one accustomed to use a microscope which has no control of its light except by a mirror and diaphragm, will temporarily replace the diaphragm by a sliding tube capable of holding his highest power eye-piece and of focusing it from below upon the object, he will be little likely to use the instrument afterward in any other way. A Kelner's eye-piece, suggested as a condenser by Mr. Brooke, and urged by Dr. Beale, would be still better; and probably Tolles' orthoscopic eye-piece would answer the same purpose. The illuminating angle would be varied by focussing below the object, with much less loss of definition than in the old style of using an objective for the same purpose; or, preferably, various stops of blackened card would be introduced below the field-lens to stop off any desired portion of the light, and similarly a disc of blue glass would be used to correct the yellow glare of artificial light. With slight mechanical ingenuity the student can combine these stops in a circular diaphragm of blackened card or brass, and somewhat increase the convenience of

his really excellent achromatic condenser. The efficiency of his apparatus will be vastly increased by adding the graduating diaphragm made by Collins and others in London and occasionally offered for sale in this country. Or, at a very reasonable expense, he can order the Webster condenser and graduating diaphragm complete of Collins or Crouch, or other London dealers. At first sight it would seem that this apparatus could not be used on stands of the "Jackson" model; but, by a little judicious filing, it can be used on large stands of this style, as I have been accustomed to do for years. After using a graduating diaphragm in the ordinary microscopical work of natural history, the orthodox wheel of apertures, with its intermittent views of the object, and its abrupt changes of light, seems simply absurd. For use without a condenser, or with one of the large lens or eye-piece form, Collins' graduating diaphragm should be used on all stands to which it can be applied; otherwise, and especially with the small lens or objective form of achromatic condenser, Zentmayer's graduating diaphragm should be used, or Brown's iris diaphragm as made by Beck. There is often some difficulty in getting the graduating diaphragm sufficiently near to the lenses in the small lens condensers, but none in the eye-piece condensers.

The easiest and most fascinating use of the stereoscopic microscope is doubtless with opaque or translucent objects with the paraboloid or other means of black-ground illumination. In lighting transparent objects under the binocular we have only one new condition introduced, the necessity of a wide horizontal illumination in order to give an even light over the whole of both fields. Focussing the condenser upon the object and gradually opening the diaphragm, we shall probably find, with a 1-inch of 25°, the best definition and resolution accomplished just at the point where both fields are fairly lighted; but with a 1-2 of 60° or a 1-4 of 75° the best definition is often gained when each field is scarcely half illuminated, and when the fields are wholly lighted the object is nearly drowned. If we now open wide the diaphragm, and introduce a blackened card disc punched with two holes (Plate 5, fig. 5) so as to give two cones of light each having an angular width about one-half or one-third of that of the objective, and converging horizontally upon the object at an angle nearly as great as that of the objective, we shall have both fields fairly and evenly lighted, and no glare. The same end is attained by a stop with a horizontal slit, giving a wide horizontal and narrow vertical pencil of light.

This expedient may be applied with some advantage even to instruments without accessories, by placing a disc like Fig. 1 of Plate 5, having an opening of suitable width, over the diaphragm, to shape the cone of light from the concave mirror; or the regular wheel of apertures may be replaced by a somewhat larger one containing one or two openings of this shape.

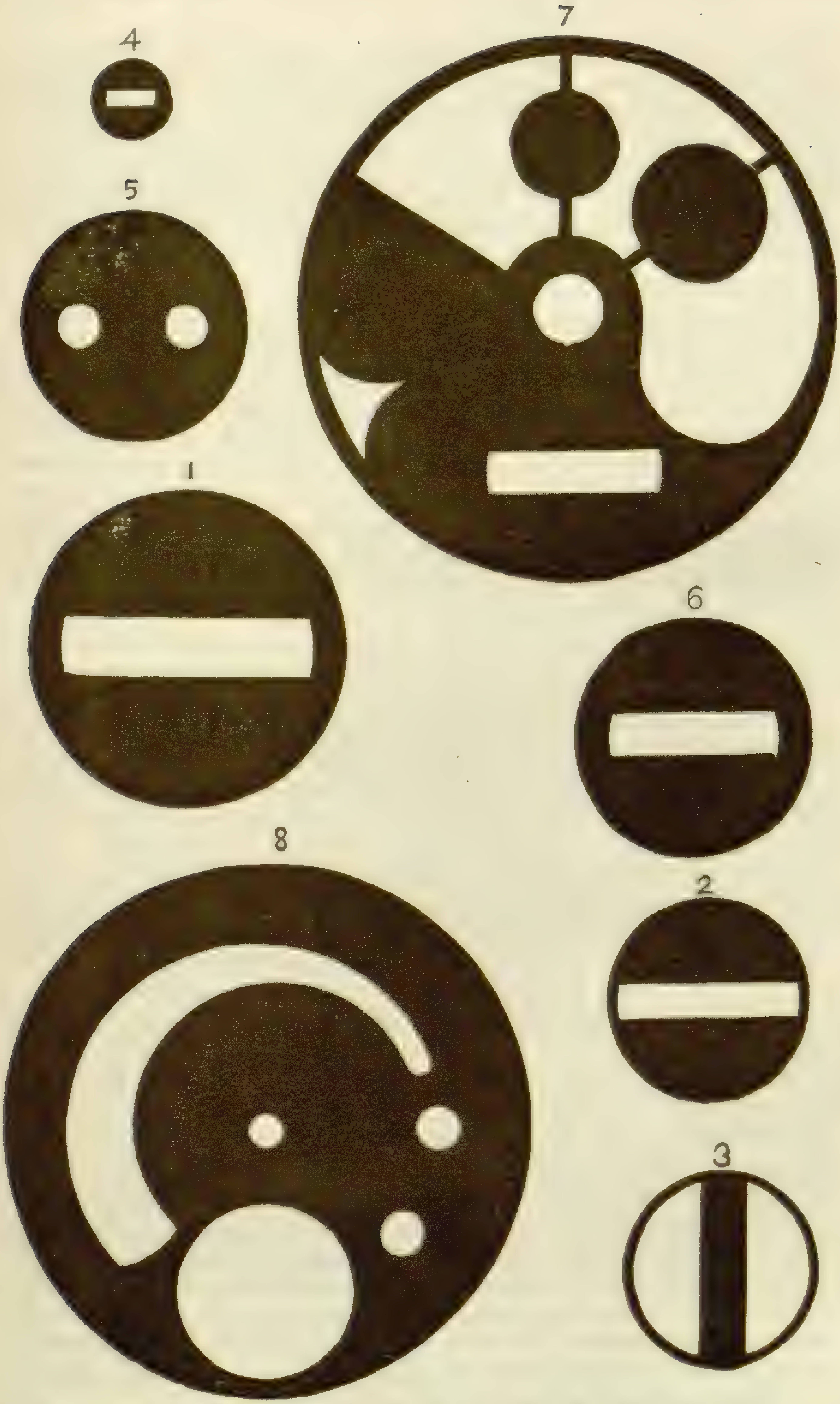
Next comes the spotted lens, which may be applied to any microscope and which will greatly increase its working power at an almost nominal

expense, giving sufficiently good black-ground and oblique-light effects for small microscopes. This lens is used for transparent illumination of both fields of the binocular with 1-2 or 1-4-inch objectives (the Webster condenser, with its smallest centre stop, and graduating diaphragm, attains the same end in a much finer manner), but much of the light passed even by it is detrimental, and its performance may be improved by a cap of card or paper, placed over it, having a horizontal opening, or a vertical stop (Plate 5, figs. 2 and 3), one of the openings in Fig. 3 being closed when oblique light is required. A horizontal opening of adjustable width may be easily combined with the brass mounting of the spotted lens.

In using an objective or similar combination as achromatic condenser the horizontal slit is still more applicable. It (Plate 5, fig. 4) may be added, for instance, to the stop-plate of Powell and Leland's achromatic condenser, or placed in the supplementary aperture of Ross' 4-10 condenser, or in small microscopes screwed in between the lenses of a condensing objective. Different stops must be used for different angles of width required, 25° or 30° being generally applicable and the length being regulated by the diaphragm-plate, or by Zentmayer's graduating diaphragm, or Brown's iris diaphragm which, instead of the diaphragm-plate, should be combined with condensers of this class.

But the real value of this stop, and the real ease of handling the light in the every-day work of the stereoscopic-microscope, is attained with the large-lens condensers, with which a 1-4 of 75°, or, when more resolving power and less depth of field is required, a 4-10 of 110° to 120°, can be as easily managed as a 1-inch, both fields being softly and evenly lighted. Paper discs like Plate 5, fig. 5, may be used, adapted to various powers and placed between the lower lens of the condenser and its stop-plate, or Plate 5, fig. 6, may be placed in the same position, or the stop-plate may be so modified as to furnish a horizontal slit as in Plate 5, fig. 7, the length of the slit being controlled by the graduating diaphragm. An adjustable slit may be extemporized by using a straight edge of card in connection with the oblique stop of the stop-plate; or it may be combined with the brass-work as a pair of shutters somewhat like those of the spectroscope, or as a supplementary wheel, like Plate 5, fig. 8, above the usual stop-plate. The large round opening in this plate (Fig. 8) should be furnished with a rim to carry any experimental stops of blackened paper that may be desired. If the two plates are of exactly the same size and properly mounted at the centre, there is not the slightest difficulty in moving each independently of the other; nor is the unequal width and curved direction of the slit any serious inconvenience in practice.

The graduating diaphragm, for facility of use and certainty of results, has fairly superseded the original wheel of apertures; perhaps the time may come when we shall equally discard the wheel of stops, and have nothing left to remind us of our circular diaphragm-plate. If the opticians would give us something having the general arrangement of the



WARD, ON THE ILLUMINATION OF BINOCULAR MICROSCOPES.

Webster condenser, but of 110°, perfectly achromatic and adjustable for thickness of the glass slide, and mounted over a graduating diaphragm, a pair of shutters for an adjustable horizontal slit (one of them, or another single shutter, capable of moving independently for oblique illumination), and a graduating centre stop capable of stopping off from 25° to 80° of light, I believe that most persons who use the instrument for the ordinary investigation in natural history would consider the combination rather as a necessary part of their stand than as an accessory to be sometimes used with it.

Dr. WALKER of New Orleans, La., read a paper prepared by Professor EUGENE W. HILGARD, State Geologist of Louisiana, on "The Upper Delta Plain of the Mississippi." The paper is one of a series by the same author, the preceding ones having treated of the older formations which characterize the geology of the Great Enlargement of the Mexican Gulf Basin, of which the Mississippi River, below Cairo, forms the axis. We are first reminded of the successive disappearance of the slightly dipping formations, in proceeding south from Vicksburg. It is shown that the delta or alluvial deposits proper, cover the older formations to a comparatively slight depth only, the river running on paludal deposits, and then on an ancient sea bottom, of corresponding (late quaternary) age, from above New Orleans to near its mouth. It thus appears that Artesian bores in the vicinity of New Orleans, tubed through the (chiefly marine) deposits of the upper strata, and penetrating the great beds of Orange sand, or southern drift, will probably furnish an abundant rise of the best of water. The great torrent which produced the northern drift is seen to have swept over the southern coast with sufficient force to transport pebbles of five to six ounces weight from far distant regions, the nearest being Tennessee and Arkansas. This great eroding agent seems also to have so cut and worn the older formations into ridges and channels, that the overlying ones vary greatly in thickness, while level at the surface. The singular phenomena known as the New Orleans Gas Wells, are also mentioned. When bores were sunk for water, the gas rushed up with such force as to carry up several cart loads of sand in a single night, and when the gas became ignited, it was extinguished with great difficulty.

An abstract of a second paper by the same author, "On the Mudlumps of the Passes of the Mississippi," was given by Prof. J. E. HILGARD. The Mudlumps are islands formed by upheavals of the bottom, off the mouths of the Passes, inside the bar. They often rise in mid-channel, obstructing navigation and diverting the current, and at times bringing up objects long ago lost from vessels. They form a number of pretty large islands, especially near the mouth of the South-west Pass. On them we frequently find springs of liquid mud, accompanied by bubbles of combustible gas; these springs often exhibit all the phenomena of mud volcanoes—extensive cones of mud, with an active crater in the middle. Most of the material of the Mudlumps seen above water, bears evidence of having once belonged to active cones, now extinct.

The author investigated the origin of these springs, by an examination of their ejecta — gas, water, and mud. The gas he found to be such as is produced by vegetable matter in its first stages of decay. The mud contains evidence of a mixed fluviatile and marine origin; while the water in which it is diffused, has the composition of sea-water changed under the influence of ferrugino-calcareous river mud, containing fermenting vegetable matter.

The conclusion reached is, that the mud is the same as that which is deposited on the "blue clay bottom" of the Gulf, outside the bar, in a semi-fluid state. In its annual advance, the bar covers this mud stratum, which exists equally higher up the Passes; the increase in weight by vegetation, alluvion, etc., of the new formed land above, as well as that of the bar below the mouth, causes the bottom to bulge upwards at the points of least resistence, *i. e.* in the deepest channel.

Attention was called to the fact, that of all rivers known, the Mississippi is the only one exhibiting either mudlump action, or the peculiar narrow lands of bank, advancing rapidly towards deep water, which are known as "necks," and are obviously dependent on the mudlumps for their origin. It is therefore permissible to infer, not only that all the similarly shaped alluvions above the head of the Passes, at least as far as the forts, have been formed by mudlump action, but also that the latter will cease so soon as the bar, in its advance, shall pass beyond the shelf of "blue clay botton" (presumably of the Port Hudson age), into the deep water of the Gulf; which point is now nine miles out from the mouth.

Professor W. C. Kerr read a paper on "A Point in Dynamical Geology." This paper called attention to the agency of the sun as a probable and sufficient explanation of the well-known remarkable coincidences of the coast lines, mountain systems and chains of islands, — nearly all the great "feature-lines" in the physiognomy of the globe,—with the arcs of great circles tangent to the polar circles; the exceptions being generally arcs of great circles perpendicular to the former; inasmuch as the sun oscillates about (within 1° of) a position ($\pm$ 22 1-2° declination), which is approximately polar to the above system of great circles, for *more than one quarter of the year;* and all the solar influences, mechanical (tidal), thermal, electromagnetic and chemical, being in full play for this long period, about this great dynamical plane which separates the luminous from the dark hemisphere, could not conceivably have failed to exercise a profound influence in outlining the rising ("becoming") features of the globe in its plastic and formative state. Similar considerations are applicable to the lunar influence, which was cumulative in the same direction.

The Oneonto and Montrose Sandstone, etc. — In the Report of my paper on the Oneonto and Montrose Sandstone etc., the language may convey the idea that the sandstones of both these localities have been identified with the Portage Group, which was not intended. The Oneonto Sandstone is pretty clearly an equivalent of the Portage Group of Central

and Western New York, while up to this time no positive determination has been made regarding the Sandstone of Montrose. The latter may be the equivalent of the Red Sandstone of Tioga and of the summits of the Catskill, but we have not yet the facts necessary for the determination. Will you have the kindness to make some note of correction in the next number of the NATURALIST. Yours, etc. — JAMES HALL.

The following papers were also read before the Association: —

PAPERS READ IN SECTION B. — NATURAL HISTORY.

Notes on Granitic Rocks. By *T. Sterry Hunt.*

On the Oil-Bearing Limestone of Chicago. By *T. Sterry Hunt.*

On the Lignites of West America, their Distribution and Economic Value. By *J. S. Newberry.*

On the character of the Observations necessary to interpret the record of the last Glacial Period. By *N. S. Shaler.*

Microscopic Circuits of Generation: *a.* Of Zymotic Fungi: *b.* Of the (nominal) Genera of Fresh water Algæ, as development-phases of Bryaceæ, etc. *c.* Of Vorticello-Planarians. By *T. C. Hilgard.*

The Genetic Relations of the Arietes. By *Alpheus Hyatt.*

On the occurrence of native iron, not meteoric. By *H. B. Nason.*

On the salt deposit of Western Ontario. By *T. Sterry Hunt.*

On the Relation of Organic Life of the several continents to the Physical Character of those land areas. By *N. S. Shaler.*

The Development and Old Age of the Tetrabranchiate Cephalopods. By *A. Hyatt.*

On a method of collecting certain Geological facts, adopted by the "Social Science Association." By *N. S. Shaler.*

On the Sequence and Chronology of the Drift Phenomena in the Mississippi Valley By *J. S. Newberry.*

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Observations on the Geography and Archæology of Peru. By E. G. Squier. London, 1870. 8vo.

Feuille des Jeunes Naturalistes. Nos. 1-5. May to August, 1870. Dornach, Haut-Rhin. ($1.00 gold a year.) 8vo, pp. 8.

Report on the Mollusca of Long Island, N. Y., and of its Dependencies. By Sanderson Smith and Temple Prime. New York. 8vo, pp. 30.

Annals of the Lyceum of New York. pp. 345-376. 1870.

American Journal of Conchology. Vol. vi, part 2. November, 1870. Philadelphia.

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THE ANCIENT LAKES OF WESTERN AMERICA: THEIR DEPOSITS AND DRAINAGE.*

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THE wonderful collections of fossil plants and animal remains brought by Dr. Hayden from the country bordering the Upper Missouri have been shown by his observations, and the researches of Mr. Meek, to have been derived from deposits made in extensive fresh-water lakes; lakes, which once occupied much of the region lying immediately east of the Rocky Mountains, but which have now totally disappeared. The sediments that accumulated in the bottoms of these old lakes show that in the earliest periods of their history they contained salt water, at least that the sea had access to them, and their waters were more or less impregnated with salt, so as to be inhabited by oysters and other marine or estuary mollusks. In due time the continental elevation which brought all the country west of the Mississippi up out of the widespread Cretaceous sea, raised these lake-basins altogether above the sea level and surrounded them with a broad expanse of dry land. Then ensued one of the most interesting chapters in the geological history of our continent, and one that, if fairly written out, could not fail to be read with pleasure by all intelligent persons. The details of

* From Dr. Hayden's forthcoming "Sun Pictures of the Rocky Mountains."

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this history are however, in a great measure, yet to be supplied; inasmuch as the great area of our western possessions is still but very partially explored, and it is certain that it forms a great treasure-house of geological knowledge, from which many generations will draw fresh and interesting material before its riches shall be exhausted.

The enlightened measures adopted by our Government for the exploration of the public domain, the organization and thorough equipment of the numerous surveying parties that have traversed the region west of the Mississippi within the last twenty years, together with the more extensive explorations by private enterprise of our great mining districts, have resulted in giving us materials from which an outline sketch can now be made that may be accepted as in all its essential particulars, accurate and worthy of confidence.

It has happened to me to be connected with three of the Government surveys, to which I have referred, and to spend several years in traversing the great area lying between the Columbia River and the Gulf of Mexico. The observations which I have made on the geological structure of our Western Territories supplement, in a somewhat remarkable way, those made by Dr. Hayden, so that taken together, our reports embody the results of a reconnoissance stretching over nearly the whole of our vast possessions west of the Mississippi.

Our knowledge of the geology of this region has also been largely increased by the no less important contributions of other explorers. Among those who deserve most honorable mention in this connection are Mr. George Gibbs, to whom we are indebted for most that we know of the geology of Washington Territory; to Professors W. P. Blake and Thomas Antisell, to Prof. Whitney and the other members of the California Geological Survey; to Baron Richtofen, the lamented Rémond, Drs. Shiel, Wislizenus, and others.

The results obtained by the last, largest and best organized party which has been engaged in Western explorations,

that of Mr. Clarence King, have not yet been given to the public, but from an examination of some of the materials which are to compose the reports of this expedition, I feel justified in saying that it will prove to be among the most important of all the series of explorations of which it forms a part, and that the published results of this expedition will be not only an important contribution to science and our knowledge of our own country, but a high honor to those by whom the work has been performed, and to the Government by which it was organized.

Without going into details or citing the facts or authorities on which our conclusions rest, I will, in a few words, give the generalities of the geological and topographical structure of that portion of our continent which includes the peculiar features that are to be more specially the subject of this paper.

It is known to most persons that the general character of the topography of the region west of the Mississippi has been given by three great lines of elevation which traverse our territory from north to south: the Rocky Mountain Belt, the Sierra Nevada and the Coast Ranges. Of these, the last is the most modern, and is composed, in great part, of Miocene Tertiary rocks. It forms a raised margin along the western edge of the continent, and has produced that "iron bound coast" described by all those who have navigated that portion of the Pacific which washes our shores.

Parallel with the Coast Mountains lies a narrow trough which, in California, is traversed by the Sacramento and San Joachin Rivers, and portions of it have received their names. Further north, this trough is partially filled, and for some distance, nearly obliterated by the encroachment of the neighboring mountain ranges, but in Oregon and Washington it reappears essentially the same in structure as further south, and is here traversed by the Williamette and Cowlitz Rivers.

These two sections of this great valley have now free

drainage to the Pacific, through the Golden Gate and the trough of the Columbia, both of which are channels cut by the drainage water through mountain barriers that formerly obstructed its flow, and produced an accumulation behind them that made these valleys inland lakes; the first of the series I am to describe of extensive fresh-water basins that formerly gave character to the surface of our Western Territory, and that have now almost all been drained away and have disappeared.

East of the California Valley lies the Sierra Nevada; a lofty mountain chain reaching all the way from our northern to our southern boundary. The crest of the Sierra Nevada is so high and continuous that for a thousand miles it shows no passes less than five thousand feet above the sea, and yet, at three points there are gate-ways opened in this wall, by which it may be passed but little above the sea-level. These are the cañons of the Sacramento (Pit River), the Klamath and the Columbia. All these are gorges cut through this great dam by the drainage of the interior of the continent. In the lapse of ages the cutting down of this barrier has progressed to such an extent as almost completely to empty the great water basins that once existed behind it, and leave the interior the arid waste that it is—the only real desert on the North American Continent.

The Sierra Nevada is older than the Coast Mountains, and projected above the ocean, though not to its present altitude, previous to the Tertiary and even Cretaceous ages. This we learn from the fact, that strata belonging to these formations cover its base, but reach only a few hundred feet up its flanks. The mass of the Sierra Nevada is composed of granitic rocks, associated with which are metamorphic slates, proved by the California Survey to be of Triassic and Jurassic age. These slates are traversed in many localities by veins of quartz, which are the repositories of the gold that has made California so famous among the mining districts of the world.

East of the Sierra Nevada we find a high and broad plateau, five hundred miles in width, and from four thousand to eight thousand feet in altitude, which stretches eastward to the base of the Rocky Mountains, and reaches southward far into Mexico. Of this interior elevated area the Sierra Nevada forms the western margin, on which it rises like a wall. It is evident that this mountain belt once formed the Pacific coast; and it would seem that then this lofty wall was raised upon the edge of the continent to defend it from the action of the ocean waves. In tracing the sinuous outline of the Sierra Nevada, it will be seen that its crest is crowned by a series of lofty volcanic cones, and that one of these is placed at each conspicuous angle in its line of bearing, so that it has the appearance of a gigantic fortification, of which each salient and reëntering angle is defended by a massive and lofty tower.

The central portion of the high table lands, to which I have referred, was called by Fremont the Great Basin, from the fact that it *is* a hydrographic basin, its waters having no outlet to the ocean. The northern part of this area is drained by the Columbia, the southern by the Colorado. Of these the Columbia makes its way into the ocean by the gorge it has cut in the Cascade Mountains, through which it flows nearly at the sea level; while the Colorado reaches the Gulf of California through a series of cañons, of which the most important is nearly one thousand miles in length, and from three thousand to six thousand feet in depth. In volume VI. of the Pacific Railroad Reports, I have described a portion of the country drained by the Columbia, and have given the facts that led me to assert that the gorge through which it passes the Cascade Mountains has been excavated by its waters; and that previous to the cutting down of this barrier these waters accumulated to form great fresh-water lakes, which left deposits at an elevation of more than two thousand feet above the present bed of the Columbia. Similar facts were observed in the country drained by the

Klamath and Pit Rivers, and all pointed to the same conclusion.

In all this region I observed certain peculiarities of geological structure that have been remarked by most of those who have traversed the interval between the Sierra Nevada and the Rocky Mountains. In the northern and middle portions of the great table lands the general surface is somewhat thickly set by short and isolated mountain ranges, which have been denominated the "Lost Mountains." These rise like islands above the level of the plain, and are composed of volcanic or metamorphic rocks. The spaces between these mountains are nearly level, desert surfaces, of which the underlying geological structure is often not easily observed. Toward the north and west, however, wherever we come upon the tributaries of the Columbia, the Klamath or Pit Rivers, we find the plateaus more or less cut by these streams and their substructure revealed.

Here the underlying rocks are nearly horizontal, and consist of a variety of deposits varying much in color and consistence. Some are coarse volcanic ash with fragments of pumice and scoria. Others I have in my notes denominated "concrete," as they precisely resemble the old Roman cement and are composed of the same materials. In many localities these strata are as fine and white as chalk, and, though containing little or no carbonate of lime, they have been referred to as "chalk-beds" by most travellers who have visited this region. Specimens of this chalk-like material gave me my first hint of the true history of these deposits. These, collected on the head waters of Pit River, the Klamath, the Des Chutes, Columbia and elsewhere, were transmitted for examination to Professor Bailey, then our most skilled microscopist. Almost the last work he did before his untimely death was to report to me the results of his observation on them. This report was as harmonious as it was unexpected. In every one of the chalk-like deposits to which I have referred he found *fresh-water diatomaceæ.*

From the stratification and horizontality of these deposits, I had been fully assured that they were thrown down from great bodies of water that filled the spaces separating the more elevated portions of the interior basin, and here I had evidence that this water was fresh. Since that time a vast amount of evidence has accumulated to confirm the general view then taken of the changes through which the surface of this portion of our continent has passed. From South-western Idaho and Eastern Oregon I have now received large collections of animal and vegetable fossils of great variety and interest. Of these the plants have been, for the most part, collected by Rev. Thomas Condon, of the Dalles, Oregon, who has exposed himself to great hardship and danger in his several expeditions to the localities in Eastern Oregon, where these fossils are found. The plants obtained by Mr. Condon are apparently of Miocene age, forming twenty or thirty species, nearly all new and such as represent a forest growth as varied and luxuriant as can be now found on any portion of our continent.

The animal remains contained in these fresh-water deposits have come mostly from the banks of Castle Creek, in the Owyhee district, Idaho. The specimens I have received were sent me by Mr. J. M. Adams, of Ruby City. They consist of the bones of the mastodon, rhinoceros, horse, elk and other large mammals, of which the species are probably in some cases new, in others identical with those obtained from the fresh-water Tertiaries of the "Bad Lands" by Dr. Hayden. With these mammalian remains are a few bones of birds and great numbers of the bones and teeth of fishes. These last are cyprinoids allied to *Mylopharodon*, *Milocheilus*, etc., and some of the species attained a length of three feet or more. There are also in this collection large numbers of fresh-water shells of the genera *Unio*, *Corbicula*, *Melania* and *Planorbis*.* All these fossils show that at one

*One of the most common is a species of *Tiara* closely resembling an East Indian one, while the genus no longer exists in this continent.

period in the history of our continent, and that geologically speaking quite recent, the region under consideration was thickly set with lakes, some of which were of larger size and greater depth than the great fresh-water lakes which now lie upon our northern frontier. Between these lakes were areas of dry land covered with a luxuriant and beautiful vegetation, and inhabited by herds of elephants and other great mammals, such as could only inhabit a well-watered and fertile country. In the streams flowing into these lakes, and in the lakes themselves, were great numbers of fishes and mollusks of species, which, like the others I have enumerated, have now disappeared. At that time, as now, the great lakes formed evaporating surfaces, which produced showers that vivified all their shores. Every year, however, saw something removed from the barriers over which their surplus water flowed to the sea and, in the lapse of time, they were drained to the dregs. In the Klamath lakes, and in San Francisco, San Pablo and Suisun bays, we have the last remnants of these great bodies of water; while the drainage of the Columbia lakes has been so complete, that in some instances, the streams which traverse their old basins have cut two thousand feet into the sediments which accumulated beneath their waters.

The history of this old lake country, as it is recorded in the alternations of strata which accumulated at the bottoms of its water basins, will be found to be full of interest. For while these strata furnish evidence that there were long intervals when peace and quiet prevailed over this region, and animal and vegetable life flourished as they now do nowhere on the continent, they also prove that this quiet was at times disturbed by the most violent volcanic eruptions, from a number of distinct centres of action, but especially from the great craters which crowned the summit of the Sierra Nevada. From these came showers of ashes which must have covered the land and filled the water so as to destroy immense numbers of the inhabitants of both. These ashes

formed strata which were, in some instances ten or twenty feet in thickness. At other times the volcanic action was still more intense, and floods of lava were poured out which formed continuous sheets, hundreds of miles in extent, penetrating far into the lake-basins, and giving to their bottoms floors of solid basalt. When these cataclysms had passed, quiet was again restored, forests again covered the land, herds dotted its pastures, fishes peopled the waters, and fine sediments abounding in forms of life accumulated in new sheets above the strata of cooled lava. The banks of the Des Chutes River and Columbia afford splendid sections of these lake deposits, where the history I have so hastily sketched may be read as from an open book.

But, it will be said that there are portions of the great central plateau which have not been drained in the manner I have described. For, here are basins which have no outlets, and which still hold sheets of water of greater or less area, such as those of Pyramid Lake, Salt Lake, etc. The history of these basins is very different from that of those already mentioned but not less interesting nor easily read. By the complete drainage of the northern and southern thirds of the plateau through the channels of the Columbia and Colorado, the water surface of this great area was reduced to the tenth or one-hundredth part of the space it previously occupied. Hence, the moisture suspended in the atmosphere was diminished in like degree, and the dry hot air, sweeping over the plains, licked up the water from the undrained lakes until they were reduced to their present dimensions. Now, as formerly, they receive the constant flow of the streams that drain into them from the mountains on the east and west, but the evaporation is so rapid that their dimensions are not only not increased thereby, but are steadily diminishing from year to year. Around many of these lakes, as Salt Lake, for example, just as around the margins of the old drained lakes, we can trace former shore lines and measure the depression of the water level. Many of these lakes

of the Great Basin have been completely dried up by evaporation, and now their places are marked by alkaline plains or "salt flats." Others exist as lakes only during a portion of the year, and in the dry season are represented by sheets of glittering salt. Even those that remain as lakes are necessarily salt, as they are but great evaporating pans where the drainage from the mountains—which always contains a portion of saline matter—is concentrated by the sun and wind until it becomes a saturated solution and deposits its surplus salts upon the bottom.

The southern portion of the great central table land—that which has been denominated the Colorado Plateau—is almost without mountain barriers or local basins, and we, therefore, find upon it fewer traces of ancient lakes, though they are not entirely wanting. It is apparent, however, that this high plateau, which stretches away for several hundred miles west of the Rocky Mountains, was once a beautiful and fertile district. The Colorado draining then, as now, the western ranges of the Rocky Mountains, spread over the surface of this plateau, enriching and vivifying all parts of it. When it reached the western margin of the table land, however, it poured over a precipice or slope five thousand feet in height, into the Gulf of California, which then reached several hundred miles farther north than now. In process of time the power developed by this stupendous fall cut away the rock beneath the flowing water, and formed that remarkable gorge to which I have already referred. This gorge is nearly one thousand miles in length and from three thousand to six thousand feet in depth, and is cut through all the series of sedimentary rocks from the Tertiary to the granite, and has worn out the granite to a depth of from six hundred to eight hundred feet. Just in proportion as the Colorado deepened its channel, the region bordering it became more dry, until ultimately the drainage from the mountains passed through it in what may be even termed "underground channels," and contributed almost nothing

to the moisture of the surrounding country. The reason why the walls of this cañon stand up in such awful precipices of thousands of feet is, that the perennial flow of the stream is derived from far distant mountains; almost no rain falls upon its banks, and when any portion of the bordering cliff has passed beyond the reach of the stream, it stands almost unaffected by atmospheric influences.

On the east of the Rocky Mountains lies the country of the "plains," a region not unlike in its topography to the great plateau of the West, but differing in this: that it is not bordered on the east by a continuous mountain chain; that it slopes gently downward to the Mississippi, and that its eastern half has been so well watered that the valleys have been made broad and all its topographical features softened down. In former times, however, the topographical unity now conspicuous on the plains did not exist, and the surface was marked by a series of great basins which received the flow of water from the Rocky Mountains and formed lakes, less numerous, it is true, but of greater extent than those of the far West. The northern portion of the eastern plateau has been Dr. Hayden's chosen field of exploration for many years; a field he has well tilled, and from which he has obtained a harvest of scientific truth which will form for him an enduring and enviable monument.

Among the most interesting researches of Dr. Hayden in this region, are the studies he has made of the deposits which have accumulated in these great fresh-water basins. The story he has written of his explorations of this district has been so well and fully told that I shall not attempt to repeat it. Suffice it to say, that the series of fresh-water basins discovered by Dr. Hayden in the country bordering the Upper Missouri have proved to be as rich in new and interesting forms of animal and vegetable life as any that have been found upon the earth's surface. The vertebrate remains collected by Dr. Hayden have been studied, described and illustrated by Dr. Liedy, and the splendid monograph which

he has published of these fossils, forms a contribution to paleontology not second in value or interest to that made by Cuvier in his illustrations of the fossils from the Paris basin; nor to that of Falconer and Cautley, descriptive of the fossils of the Sewalik hills of India.

The scarcely less voluminous and interesting collections of fossil plants made by Dr. Hayden have been placed in my hands for my examination. Of these, the first instalments were described and drawn some years since as a contribution to the report of Colonel W. F. Reynolds, U.S.A., a report not yet published by the Government. The descriptions, however, were printed in the Annals of the Lyceum of Natural History of New York, vol. ix, 1868.

The general conclusions drawn from a study of this portion of Dr. Hayden's collections as regards the floras of the Tertiary and Cretaceous periods, the topography and climate of the interior of the continent, form a part of my contribution to Colonel Reynolds' report. Since that report was written, however, very large additions have been made to our knowledge of our later extinct floras, by collections of fossil plants made in different portions of the western part of our continent by Dr. Hayden, Mr. Condon, Dr. Le Conte and myself; and also by the collections made by Mr. W. H. Dall and Captain Howard in Alaska, and by several explorers on the continent of Greenland.

Deferring for the present a comparison of the plants derived from strata of similar age in these widely separated localities, and the inferences deducible from them as regards the physical geography of our continent, I will say that the flora and fauna of the lake deposits on both sides of the Rocky Mountains apparently belong to one and the same geological age, and tell the same story in regard to the topography, climate, conditions and development of animal and vegetable life. There is this striking difference, however, perceptible at the first glance between the fresh-water Tertiaries of the east and west. In Oregon, Idaho and

Nevada, volcanic materials have accumulated in the lake basins to a much greater extent than east of the Rocky Mountains; and we have abundant evidence that during the Tertiary period the western margin of the continent was the scene of far greater volcanic activity than we have any record of in the Rocky Mountain belt.

The deposits formed by the lake basins of the Upper Missouri region are shales, marls and earthy limestones, with immense quantities of lignite, but with almost no traces of volcanic products. The number of fossil plants and animals is much greater there than farther West; and we have, in these deposits, proof that during unnumbered ages this portion of the continent exhibited a diversified and beautiful surface, which sustained a luxuriant growth of vegetation and an amount of animal life far in excess of what it has done in modern times. This condition of things existed long enough for hundreds and even thousands of feet of sediment to accumulate in the bottoms of extensive fresh-water lakes. These lakes were gradually and slowly diminished in area by the filling up of their basins and by the slow wearing away of the barriers over which passed their gently flowing, draining streams.* Since the deposition of the fresh-water Tertiaries, which occupy the places of the old lakes, great changes have taken place in the topography of this region by the upheaval of portions of the Rocky Mountain ranges. In some localities these lake deposits are found turned up on edge and resting on the flanks of the mountains which border the plains on the west. It is certain, however, that much of the Rocky Mountain belt existed anterior to this date. We have in these, and many other facts that might be cited, proofs of the truth of the assertion I have elsewhere made that these great mountain chains, though existing at least in embryo from the earliest paleozoic ages, have, since then, been subject to many and varied modifications—that they have been, in fact, hinges upon which the great plates of the continent have turned—lines

of weakness where the changes of level experienced by the continent have been most sensibly felt.

It is a somewhat remarkable fact that the collections of fossil plants made by Dr. Hayden from different localities differ so much among themselves. In every newly discovered plant-bed he has obtained more or less species of which we before had no knowledge, and it is even true that between some of his collections there are no connecting links. It is also true that much of the material he has collected has not yet received the study it needs. From these facts it will be seen that much yet remains to be done before the great interval of time during which this series of fresh-water Tertiaries accumulated can be divided into definite periods, and before we can venture to affirm that a flora of any epoch had such or such a botanical character and, therefore, this or that average annual temperature. Some interesting facts came out, however, at once in the examination of these materials; to these I will briefly refer.

In the beginning of the Cretaceous age, North America, as we know, presented a broad land surface, having a climate similar to the present, and covered with forests consisting, for the most part, of trees belonging to the same genera with those that now flourish upon it. In the progress of the Cretaceous age, the greater part of the continent west of the Mississippi sank beneath the ocean, and the deposits made during the later portions of the Cretaceous age contain a vegetation more tropical in character than that which had preceded it. It seems probable that at this time the lands which existed as such, west of the Mississippi, were islands of limited extent, washed by the Gulf Stream, which apparently had then a course north and west from the Gulf of Mexico to the Arctic Sea.

The earlier Tertiary epochs were, however, marked by an emergence of the continent and a gradual approach to previous and present conditions. This is indicated by the fact that the oldest Tertiary deposits (Eocene?) contain a flora

less like the present than is that of the Miocene or Middle Tertiary. In this category of older deposits with a more tropical flora, I would place the Green River Tertiary beds, those of Mississippi studied by Lesquereux, and those of Brandon, Vermont.

In the Miocene age, the continental surface was broader, the lake basins of the West contained only fresh water, and the land surface was covered with a vegetation very much like that of the present day; a number of Miocene species still existing. The climate of the continent in the Miocene age was much milder than now. Fan-palms then grew as far north as the Yellowstone River, and a flora flourished in Alaska and on Greenland as varied and as luxuriant as now grows along the fortieth parallel. At this time there must have been some sort of land connection between our continent and Europe on the one hand and Asia on the other. The flora of all these regions was essentially the same, and a large number of plants were common to the three continents. In this age the mammalian fauna of our continent exhibited the same remarkable development that it did in Europe and Asia; and over our western plains roved herds of great quadrupeds rivalling in number and variety those that have struck with wonder and surprise every traveller in South Africa.

This state of things seems to have continued through the Pliocene age and up to the time when the climate of the continent was completely revolutioned by the advent of the "Ice period." The change which took place at that time was such as taxes the imagination to conceive of, as much as it taxes the reasoning powers to explain.

We have seen that in the Middle Tertiary age the climate of Alaska and Greenland was that of New York and St. Louis at present. In the next succeeding period, the glacial epoch, the present climate of Greenland was brought down to New York, and all the northern portion of the continent wrapped in ice and snow. This change was undoubtedly

gradual (for nature does not often "turn a corner"), but it is plain that it must have resulted in the gradual driving southward of all the varied forms of animal and vegetable life that were spread over the continent to the Arctic Sea. When glaciers reached as far south as the fortieth parallel it is evident that a cold-temperate climate prevailed in Mexico, and that only in the south of Mexico would the average annual temperature have been what it was previously in the latitude of New York. We must conclude, therefore, that the herds of mammals which once covered the plains of the interior of North America were forced by the advancing cold into such narrow limits in Southern Mexico that nearly all were exterminated. Plants bore their expatriation better; inasmuch as a tree, even of the most gigantic size, will live upon the space occupied by its roots provided the climatic conditions are favorable; while one of the larger mammals would require at least a thousand times this space for its support. As a consequence, we find the present flora of our continent much more like that of the Miocene than is our fauna, though the change to which I have referred seems to have been fatal to quite a number of the most abundant and interesting of our Miocene forest trees. Of these, the *Glyptostrobus* may be taken as an example. This was a beautiful conifer which, in Miocene times, grew all over our continent and over Northern Europe. In the change to the glacial period, however, it was exterminated, both there and here, yet continued to exist in China—where a Miocene colony from America had taken root—and it is growing there at the present time. This great ice-wedge which came down from the north separated very widely many elements in our Miocene flora which have never since been re-united, so that when the storm had passed and better days had come, and the Mississippi Valley and the Atlantic States were re-possessed by the descendants of the Tertiary plants, they were still separated, by many thousand miles, from their brethren which had formerly crossed the now submerged bridge of

Behring's Straits; and thus the two kindreds have been growing, and flowering, and seeding, and dying in each colony far beyond the reach of the other, and developing their peculiarities each in its own way from generation to generation. When now we come to compare the present flora of China and Japan with that of the eastern half of our continent we find the strongest proofs of their intimate relationship. Many of the species are identical, while others are but slightly changed and, on the whole, the differences are less than such as have grown out of separation in human kindred colonies in an infinitely shorter period.

Among the great mammals that formerly inhabited our continent but such as are now extinct, there were some which seem to have bid defiance to the changes I have detailed. These were particularly the mastodon and elephant, both of which were probably capable of enduring great severity of climate. The mammoth we know was well defended from the cold by a thick coat of hair and wool, and was probably capable of enduring a degree of cold as severe as that in which the musk-ox now lives. We know that both these great monsters — the elephant and mastodon — continued to inhabit the interior of our continent long after the glaciers had retreated beyond the upper lakes, and when the minutest details of surface topography were the same as now. This is proven by the fact that we not unfrequently find them embedded in peat in marshes which are still marshes where they have been mired and suffocated. It is even claimed that here, as on the European continent, man was a cotemporary of the mammoth, and that here as there, he contributed largely to its final extinction. On this point, however, more and better evidence than any yet obtained is necessary before we can consider the cotemporaneity of man and the elephant in America as proven. The wanting proof may be obtained to-morrow, but to-day we are without it.

The pictures which geology holds up to our view of North America during the Tertiary ages, are in all respects but

one, more attractive and interesting than could be drawn from its present aspects. Then a warm and genial climate prevailed from the Gulf to the Arctic Sea; the Canadian highlands were higher, but the Rocky Mountains lower and less broad. Most of the continent exhibited an undulating surface; rounded hills and broad valleys covered with forests grander than any of the present day, or wide expanses of rich savannah over which roamed countless herds of animals, many of gigantic size, of which our present meagre fauna retains but a few dwarfed representatives. Noble rivers flowed through plains and valleys, and sea-like lakes broader and more numerous than those the continent now bears diversified the scenery. Through unnumbered ages the seasons ran their ceaseless course, the sun rose and set, moons waxed and waned over this fair land, but no human eye was there to mark its beauty or human intellect to control and use its exuberant fertility. Flowers opened their many-colored petals on meadow and hill-side, and filled the air with their fragrance, but only for the delectation of the wandering bee. Fruits ripened in the sun, but there was no *hand* there to pluck, nor any speaking tongue to taste. Birds sang in the trees, but for no ears but their own. The surface of lake or river was whitened by no sail, nor furrowed by any prow but the breast of the water fowl; and the far-reaching shores echoed no sound but the dash of the waves, and the lowing of the herds that slaked their thirst in the crystal waters.

Life and beauty were everywhere; and man, the great destroyer, had not yet come, but not all was peace and harmony in this Arcadia. The forces of nature are always at war, and redundant life compels abundant death. The innumerable species of animals and plants had each its hereditary enemy, and the struggle of life was so sharp and bitter that in the lapse of ages many genera and species were blotted out forever.

The herds of herbivores — which included nearly all the

genera now living on the earth's surface, with many strange forms long since extinct—formed the prey of carnivores commensurate to these in power and numbers. The coo of the dove and the whistle of the quail were answered by the scream of the eagle; and the lowing of herds and the bleating of flocks come to the ear of the imagination, mingled with the roar of the lion, the howl of the wolf, and the despairing cry of the victim. Yielding to the slow-acting but irresistible forces of nature, each in succession of these various animal forms has disappeared till all have passed away or been changed to their modern representatives, while the country they inhabited, by the upheaval of its mountains, the deepening of its valleys, the filling and draining of its great lakes, has become what it is.

These changes which I have reviewed in an hour seem like the swiftly consecutive pictures of the phantasmagoria or the shifting scenes of the drama, but the æons of time in which they were effected are simply infinite and incomprehensible to us. We have no reason to suppose that *terra firma* was less firm, or that the order of nature, in which no change is recorded within the historic period, was less constant then than now. At the present rate of change—throwing out man's influence—a period infinite to us would be required to revolutionize the climate, flora and fauna, and there is no evidence that changes were more rapid during the Tertiary ages.

Every day sees something taken from the rocky barrier of Niagara; and, geologically speaking, at no remote time our great lakes will have shared the fate of those that once existed at the far West. Already they have been reduced to less than half their former area—and the water level has been depressed three hundred feet or more. This process is likely to go on until they are completely emptied.

The cities that now stand upon their banks will, ere that time, have grown colossal in size, then gray with age, then have fallen into decadence and their sites be long forgotten,

but in the sediments that are now accumulating in these lake-basins will lie many a wreck and skeleton, tree-trunk and floated leaf. Near the city sites and old river mouths these sediments will be full of relics that will illustrate and explain the mingled comedy and tragedy of human life. These relics the geologist of the future will probably gather and study and moralize over as we do the records of the Tertiary ages. Doubtless he will be taught the same lesson we are, that human life is infinitely short, and human achievement utterly insignificant. Let us hope that this future man, purer in morals and clearer in intellect than we, may find as much to admire in the records of this first epoch of the reign of man, as we do in those of the reign of mammals.

THE CHINESE IN SAN FRANCISCO.

BY REV. A. P. PEABODY, D.D.

The Chinese form from a seventh to a fifth part of the entire population of San Francisco, and are seen in considerable numbers in all parts of California. They mingle with no other race; they learn or profess to know enough and only enough of the English tongue to transact their necessary business with their employers; and in San Francisco they live almost wholly in their own crowded quarters, which constitute in all respects a city by itself.

In the street they are the cleanest and neatest of people. Every man and boy has his *queue* of hair, as long as himself, nicely wrapped in silk braid, and generally rolled round the head. Their principal garment is a dark blue, close-fitting frock. Their shoes are of silk or cloth, with felt soles.

Their houses are dirty beyond description. Scores and even hundreds of them are sometimes huddled together in the same building, with blankets for their only beds, and

almost their only furniture. In these houses their simple cooking is performed in the long halls into which their apartments open, over furnaces, with no legitimate outlet for the coal-smoke, which leaves its black and greasy deposit half an inch thick on the ceiling and walls. I went into several of their fashionable restaurants, and found them hardly less filthy than their lodgings, yet with a marvellous variety of complicated and indescribable delicacies, which a year's income of the establishment might have tempted me to touch, but certainly not to taste.

Their provision-shops contain little except pork, and that, seldom in a form in which it would be recognized by an unpractised eye. Every part of the swine, even the coagulated blood, is utilized; and the modes in which the various portions of the beast are chopped, minced, wrapped in intestines, dried almost to petrifaction, commingled with nauseous seasonings, pique the curiosity as much as they offend the nostrils of the American observer.

Their theatres offer an amazing spectacle. Their performances commence early in the forenoon, and last till midnight. Their plays are said to be historical, and they are often continued for several days. The scenery is simple, cheap, and gaudy, and is never changed. The costumes are splendid, with a vast amount of gilding and of costly materials, but inexpressibly grotesque, and many of the actors wear hideous masks. The orchestra consists of a *tom-tom* (which sounds as if a huge brass kettle were lustily beaten by iron drumsticks), and several of the shrillest of wind-instruments. The noise they make may be music to a Chinese ear, but it consists wholly of the harshest discords, and each performer seems to be playing on his own account, and to be intent on making all the noise he can. This noise is uninterrupted, and the actors who are all men (men playing the female parts in costume), shout their parts above the din in a falsetto recitative, monotonous till toward the close of a speech, but uniformly winding up with a long-drawn, many-

quavered whine or howl. The performance is for the most part literally acting. A crowned king or queen is commonly on the stage, and almost always comes to grief. Parties of armed men meet on the stage, hold sham-fights, kick each other over, and force the sovereign into the melée. Then a rebel subject plants both his feet in the monarch's stomach, knocks him down, and himself falls backward in the very act. Thus the fight goes on, and gathers fury as its ranks are thinned, till at length the whole stage is covered with prostrate forms, which lie for a little while in the semblance of death, then pick themselves up, and scud off behind the scenes. The actors live in the theatre, though they might seem to have no living-room. I went into the principal theatre one morning, before the actors, who had been performing until a late hour, had arisen; and I found them lying in one of the passage-ways in several tiers of holes, so nearly of the size of the human body that they could only have wormed themselves in feet first.

Gambling is one of their passions. There are numerous gambling-houses where the playing goes on through the whole day and night, with an orchestra like that of the theatre, enriched by a single female singer, whose song seems a loud, shrill, ear-piercing monotone, so horrible as almost to compel the belief that the Chinese ear must have as unique a structure as if it belonged to a different species from ours.

The Chinese exercise, with marvellous skill, all the mechanical arts and trades, and have as large a variety of shops as the Americans, with wonderfully rich assortments of goods, including works in wood-carving, ivory and filigree, which can nowhere be surpassed in delicacy and beauty.

Their temples or josh-houses, are small upper rooms, with hideously grinning idols, overlaid with tinsel, and covered with tawdry ornaments, on an elevated platform at the extremity of the apartment. Before these idols a dim lamp is always burning, and a table is spread for votive offerings. which are generally cups of tea or fruits. These apartments

are in the buildings maintained by the Chinese Emigrant Aid Societies as reception-houses and hospitals, — vile dens as we should deem them, but, it is said, fully level with a Chinaman's notions of repose and comfort.

These people are by no means unintelligent. It is said that there are none of them who cannot read, write, and cast accounts; and there are among them some men of high education, polished manners, large business, and friendly, yet never intimate relations with their brother-merchants.

There is a mission-house, with a school and a chapel; but the missionary, an intelligent man and an indefatigable worker (by the way, my guide and mentor among the theatres and gambling-houses, in which he seemed very much at home, on the principle of becoming all things to all men), told me that he had gained a firm hold on very few; that he found it almost impossible to keep a small congregation together through a very short service, though many came in to listen for a little while; and that the slightest disturbance in the street, even the passing of a hand-organ, would instantly empty his chapel.

These Chinamen are generally without their families; the numerous women that live in their quarters being with very few exceptions persons of bad character. The men come to this country with the purpose of remaining but a few years; and if they die, their bodies are embalmed, and sent home for burial, Chinese corpses sometimes forming a vessel's entire freight.

The Chinese question I cannot undertake to discuss here. Suffice it to say that, in my opinion, all that can be hoped from the Chinese is the supply of cheap labor which is needed for the rapid development of a new country. As to making these people citizens who will even prize their rights, still more exercise them judiciously, or changing their older and to them satisfying type of civilization into the Anglo-Saxon Christian type, — this is utterly beyond probability or hope. If the Chinese are to be Christianized, it

must be on their own soil, and with no invasion of their ancestral habits, except the engrafting upon them of the morality of the New Testament.

THE LYCOSA AT HOME.

BY J. H. EMERTON.

Fig. 138.

Nest of Lycosa.

Last spring Mr. J. A. Lintner noticed on the sandy hills west of Albany, N. Y., a number of holes about half an inch in diameter, each surrounded by a ring of sticks and bits of leaves loosely fastened together by fine threads. A few days afterward (May 6), I carefully opened several of these holes and found in the bottom of each a large spider, a Lycosa. The holes were from six to eight inches deep and lined with a delicate web, which near the top was stout enough to be separated from the sand, forming a silken tube attached to the ring of chips around the mouth of the hole. When the holes were opened the spiders lay still in the bottom and allowed themselves to be taken out without attempting to escape. The sand at the bottom

of the holes was of a grayish color, but there were no remains of insects and no cast skins of the spider. Before opening the holes we sounded them with straws and tried to provoke the spiders to come out, but they took no notice of it. The drawing represents the ring of leaves and sticks, a section of the tube, and the spider at the bottom, all of the natural size.

LICHENS UNDER THE MICROSCOPE.

BY H. WILLEY.

THE Lichens, though among the lowest, are also among the most abundant and widely distributed orders of plants. They are the earliest to cover the naked rocks with vegetation (though none, that we are aware, have been found in a fossil condition), and by their decay, to prepare a soil on which more highly organized plants can flourish. In the Arctic zone some species are so abundant as to furnish the reindeer with the food necessary for his subsistence, and are even used as fodder for cattle and swine, and are said to increase the quantity of milk. Recently they have been used for the manufacture of brandy—a very poor use to put them to—and were formerly much employed in dyeing. Hoffman, in his work on the uses of lichens, gives plates of over seventy-five tints obtained from them. But the recent scientific discoveries in this art, have greatly diminished their use for this purpose. Some were formerly used for medical purposes, frequently in accordance with the old doctrine of signatures. *Peltigera canina* was supposed to cure hydrophobia; *Sticta pulmonaria*, the consumption, etc. But they are now considered of little, if any importance, in medicine.

Arctic travellers have found in Umbilicaria, called *tripe de roche*, a poor and bitter substitute for food, when nothing

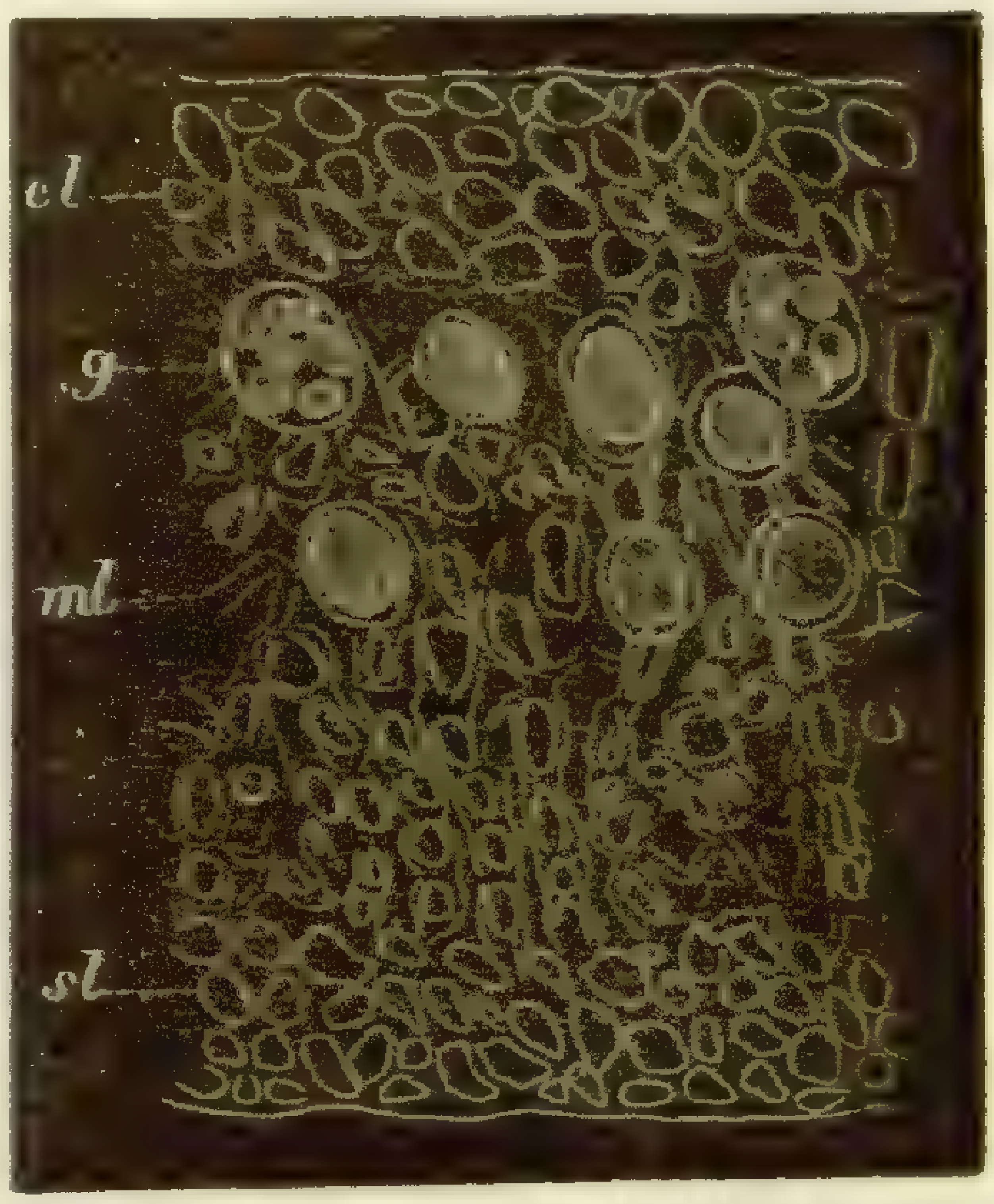
better could be obtained; and in Sweden bread has been made of the reindeer lichen in times of famine.

Lichens abound, also, in the temperate zone, especially in the mountains and the moist regions of the coast. Nearly three hundred species have been found in this vicinity (New Bedford). The number of known species, according to the most recent estimate (Krempelhueber, 1865), is about five thousand. They are to be met with everywhere. In swamps the trees are festooned with the pendulous *Usnea*. The foliaceous Parmelias, Stictas, etc., cover their trunks. The rocks and stones are everywhere covered with their spreading crusts. Some species grow on rocks covered with fresh or salt water. The brown, or scarlet fruited Cladonias, or "cup mosses," which the French call "herbe du feu" are spread over the earth. Some attain a diameter of two feet or more, while others are so small as hardly to be visible to the naked eye. Many of them are brilliantly colored, and exceedingly beautiful. They may be collected at any season of the year, are easily preserved, and their study, though not common among our botanists, owing, in a great degree, to the want of books on the subject in this country, and the necessity of using the microscope in order to become properly acquainted with them, is full of interest and instruction.

In the natural system of plants the lichens belong to the Cryptogamous, or flowerless series, which includes the ferns, mosses, algæ, and fungi. They rank below the mosses, having no distinct stem or foliage, but bearing their fruit on a foliaceous, shrubby, or crustaceous expansion, called a thallus, whence they are sometimes called Thallophytes. They have affinities on the one side with the algæ, and on the other with the fungi, and by some botanists have been included under one or the other of these orders. A recent writer, Schwendener, has propounded the theory that they are a compound plant, the thallus being a true alga, and the apothecium a fungus; but to this theory no true lichenist will be likely to assent.

The distinctive features of lichens consist in their having a thallus containing peculiar green cells, called gonidia, and in their spores being contained in asci, or spore-cases. In the latter particular the ascomycetous fungi resemble them, but these are always destitute of gonidia. A bluish reaction of the gelatinous substance of the apothecia is also characteristic of most lichens, though in some it is brown or red. In the fungi the reaction with iodine is yellow, except in a very few instances, where it is blue.

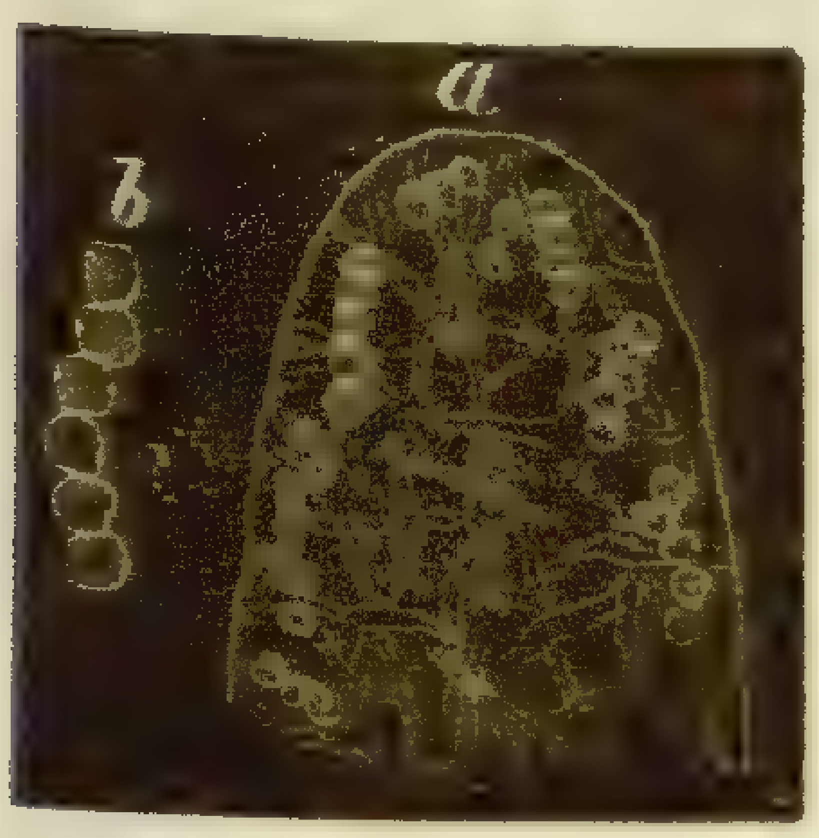
Fig. 139.



Section of thallus of *Theloschistes parietina*: *cl*, cortical layer; *g*, gonidia; *ml*, medullary layer; *sl*, inferior layer.

In order to investigate more closely the structure of the lichens, let us take any foliaceous lichen, *Theloschistes parietinus* (Fig. 139), for instance, the common orange-colored wall lichen, which occurs everywhere on stones and trunks; and having inserted a portion of the thallus in a slit made in a piece of soft cork, with a razor slice off as thin a cross-section as possible, and put it on a slide, with a drop of water, beneath a piece of thin glass, under the lens of our microscope. We shall see that it is composed entirely of cellular tissue, differing in this respect from those plants which have a vascular tissue. The upper surface, *cl*, we shall perceive to consist of a layer of cells composed of this tissue. Next beneath this is a stratum of round, greenish yellow bodies, *g*, called gonidia; then a stratum of elongated cells or filaments, *ml*, crossing each other in various directions, constituting the medullary layer; and lastly another row of cells forming the lower sur-

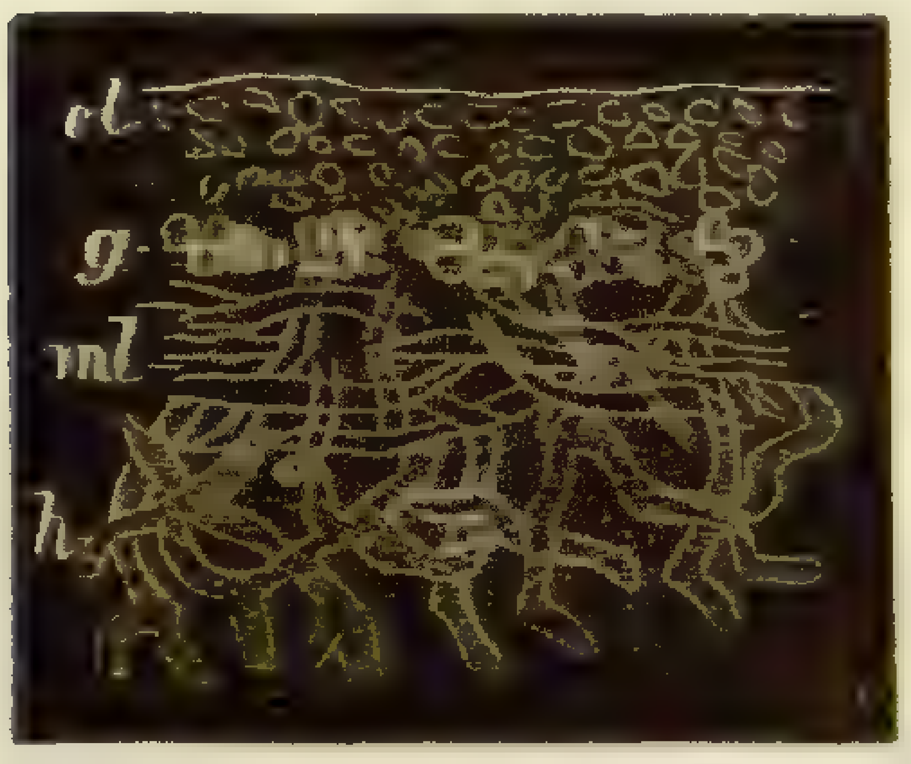
Fig. 140.



Collema leptaleum: *a*, section of thallus; *b*, moniliform gonidia.

face, *sl*, and from which proceed the slender fibres by which the plant is attached to the matrix on which it grows. These four layers make up the thallus of lichens. In some genera, as Collema (Fig. 140), the upper cellular layer is wanting, and the gonidia lie close to the surface; in others, as Peltigera, the lower is deficient, and bundles of long fibres proceed immediately from the medullary layer. These are very conspicuous and curious in *Parmelia colpodes* (Fig. 141). They constitute the hypothallus, which forms the substratum on which the other parts of the thallus are built up.

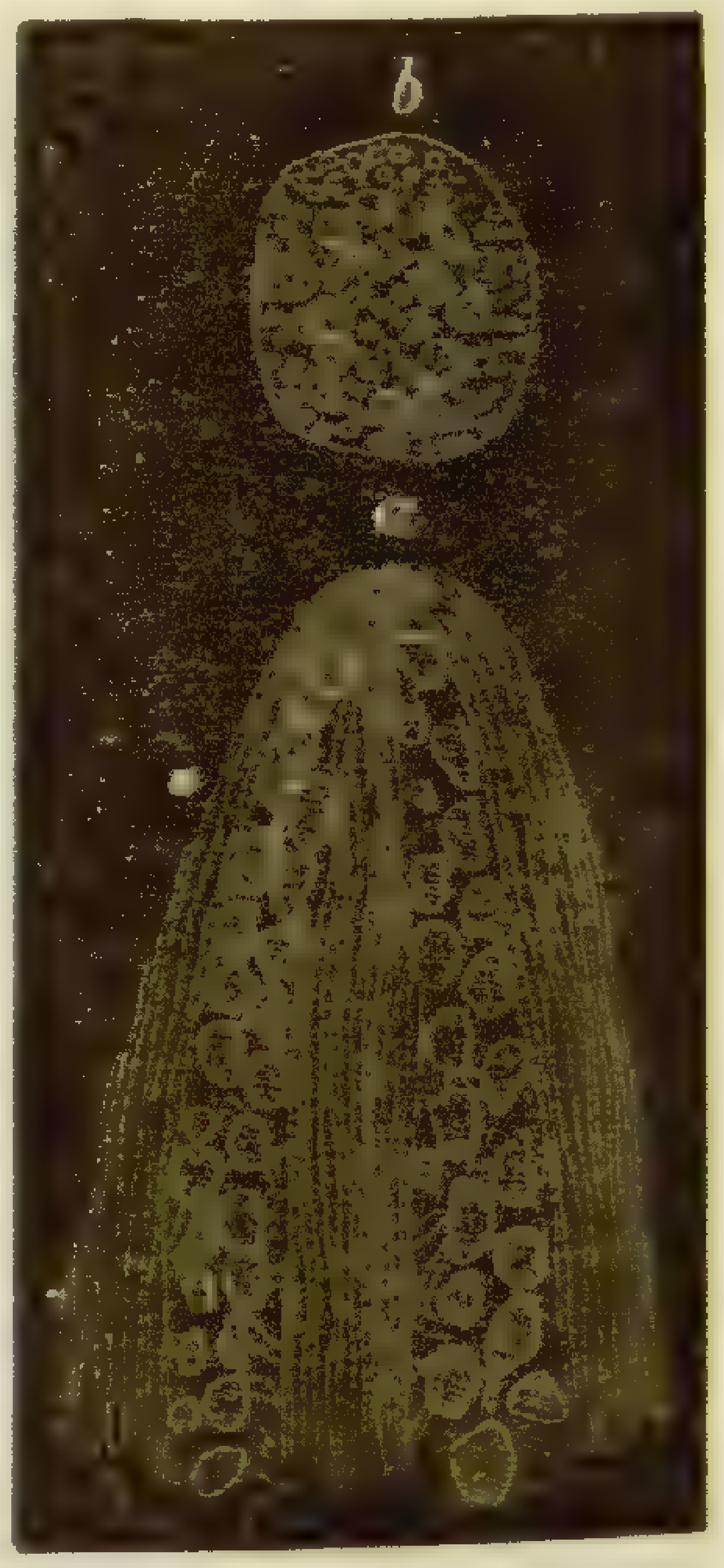
Fig 141.



Parmelia colpodes; *cl*, cortical layer; *g*, gonidia; *ml*, medullary layer; *h*, hypothallus.

In the fruticulose lichens, which bear some resemblance to the stem of a plant, the thallus is more or less rounded, and the gonidia are arranged around the medullary layer as an axis. In Usnea (Fig. 142) the thallus is solid, and the centre is composed of a mass of compact filaments lying parallel to the axis. In other genera it is hollow, or composed of loose filaments. In some genera, as Lichena, the medullary filaments, instead of running parallel to the axis, diverge from the centre to the circumference. In many crustaceous lichens the thallus consists of hardly more than a collection of gonidia, sometime buried beneath the bark, and of few filamentary elements. In these the hypothallus often forms a black border around the margin of the thallus.

Fig. 142

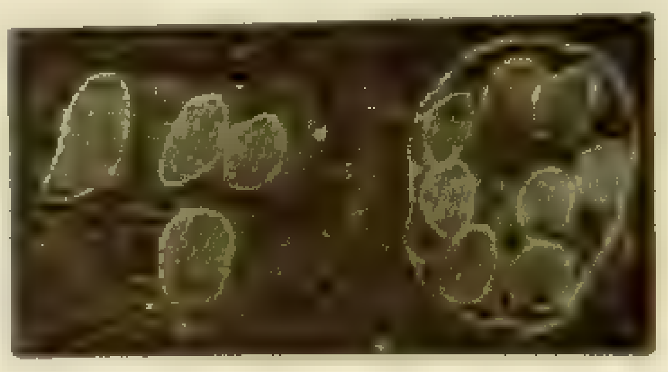


Usnea barbata; *a*, longitudinal section of thallus; *b*, cross-section of the same.

The gonidia constitute the peculiar characteristic of the lichen thallus, and are present in all true lichens, their presence being almost the only mark by which some can be

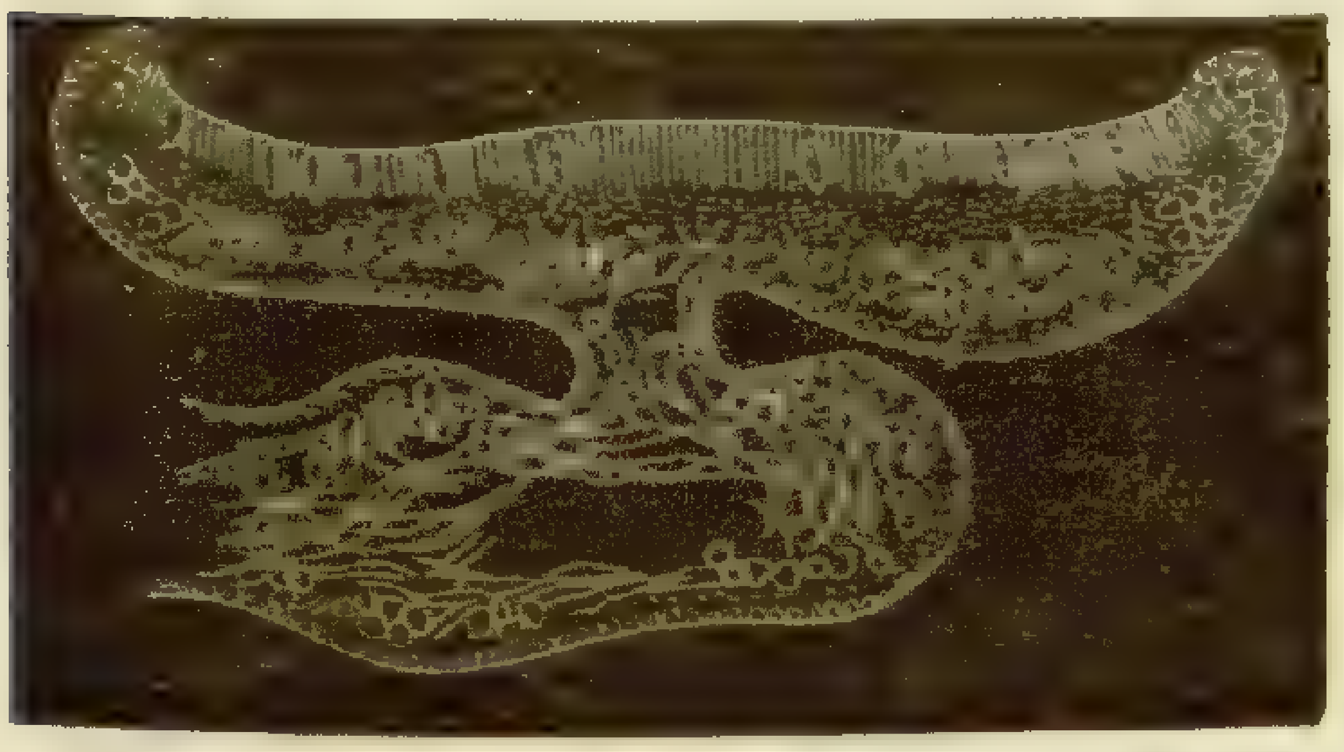
distinguished from fungi. There are some parasitic plants, consisting only of apothecia, which grow on the thallus of other lichens, called by Massalongo and Koerber, Pseudo-lichens, which are considered by some as lichens, by others as fungi. Most of them give the characteristic blue reaction with iodine. In examining a section of a young specimen of one of these, *Scutula Wallrothii* Tul. (*Biatora Heerii* Hepp), which grows on the thallus of *Peltigera canina*, I have seen a stratum of true gonidia underlying the apothecia, and extending around it. Some of these parasites are doubtless lichens, while others must be relegated to the ascomycetous fungi.

Fig. 143.



Granula gonima of *Sticta fuliginosa*.

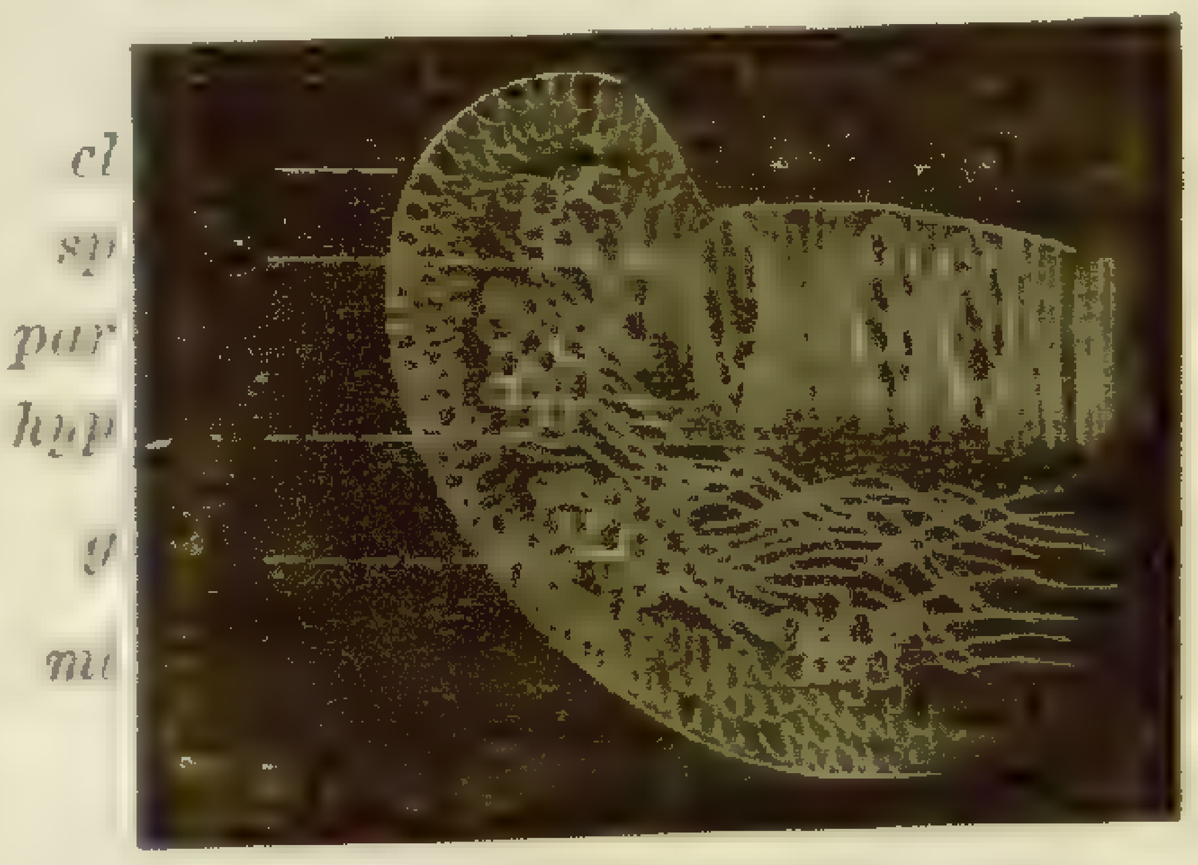
Fig. 144.



Section of apothecium of *Theloschistes parietina*.

The gonidia are either of a greenish yellow color, as mentioned above, as in Physcia, Parmelia, and the greater number of lichens; or of a bluish green, as in Collema, Peltigera, some Stictas, etc. These latter are called granula gonima, or collegonidia. In Collema they are strung together like a chaplet of beads, and are called moniliform (Fig. 140, *b*). In some genera they spring from the end of thalline filaments, in others they are grouped together, enveloped in a transparent gelatinous substance, and surrounded by a thin membrane (Fig. 143). In Synalissa both kinds of gonidia occur. They frequently burst into mealy excrescences, called soredia, on the surface of the thallus, and have the faculty of multiplying by self-division and of propagating the plant,

Fig. 145.



Portion of same more enlarged; *cl*, cortical layer; *sp*, spore-cases; *par*, paraphyses; *hyp*, hypothecium; *g*, gonidia; *ml*, medullary layer.

and in this way many lichens on which apothecia rarely or never occur, are multiplied. In some Verrucarias there are small gonidia, called hymenial gonidia, included in the hymenium.

The gelatinous substance which is found in the thallus is called lichenine. It is of a starchy nature. In many crustaceous lichens, oxalate of lime is present in considerable quantities, and may be easily recognized by its octahedric crystals. Phosphate of lime, salt, sugar, oil, with various peculiar acids, also occur, but not in great abundance.

Having thus viewed the principal features of the lichen thallus, let us now turn our attention to its organs of fructification. On looking at the lichen (Theloschistes) already selected, we shall see its surface covered with small round disks of nearly the same color as the thallus. These are the apothecia (Fig. 144), and contain the spores, the reproductive organs of the plant. Making a thin perpendicular section of one of these, and placing it under ou1 lens, we shall see that it is surrounded by a margin containing gonidia like the thallus. The interior (Fig. 145) is composed of a mass of parallel filaments, called paraphyses, among which are the asci, or spore-cases. This interior portion is called the hymenium. That part which contains the paraphyses and asci is called the thalamium, and the portion below it, the hypothecium.

Those lichens whose fruit has an open disk, are called gymnocarpous. The margin of the disk is called the exciple. When formed from the thallus, and containing gonidia, it is called a thalline exciple ; when otherwise, a proper exciple. The thalline exciple is usually pale, yellow, brown, red, or of the same color as the thallus, though it often blackens. The proper exciple is either black, as in Lecidea, or colored, as in Biatora. But in many lichens with a thalline exciple, it often assumes a biatorine form. The exciple is sometimes double, as in Gyalecta. The color of the disk varies greatly, being flesh-colored, yellow, red, brown, or

black. In some species, as *Nephroma arctica* and *Parmelia perforata*, the apothecium attains a large size. In Cladonia it is borne on the summit of a hollow stalk, called a podetium; in Calicium on a slender solid stem. In the Graphides, or "written" lichens, the apothecia are elongated and narrow, branched or stellate, and bear a rude resemblance to written characters.

Fig. 146.

Spore-case of *Theloichistes parietina*, with spores.

In many genera, such as Verrucaria, the apothecia are closed, and these are called angiocarpous. These apothecia are usually black, conical, with a small opening at the summit. Their covering is sometimes called the perithecium. But there is no fixed line of demarcation between the gymnocarpous and the angiocarpous lichens.

The paraphyses are sometimes long and thread-like, and

Fig. 147.

Spores. *a*, simple colored spore of *Calicium phæocephalum*.
b, diblastish " " *Ramalina calicaris*.
c, tetrablastish " " *Buellia vernicoma*.
d, acicular " " *Biatora rubella*.
e, fusiform " " *Collema flaccidum*.
f, muriform " " *Buellia petræa*.

easily separated, sometimes short and closely agglutinated, and, as in Arthonia, are sometimes entirely wanting. In this genus the exciple is also wanting. The paraphyses and spore-cases are generally colored blue, sometimes red or brown, by a solution of iodine.

The spore-cases, which lie among the paraphyses, are sacks usually of an oblong or club-shaped form, sometimes lanceo-

late or globose. In some genera, as Calicium, they disappear early, and the spores then appear to be free. But they are usually persistent, and a little pressure is required to separate the parts and bring out the spores. In the plant under examination there are eight of them in each spore-case. This is the usual number. But many species have one, two, four, sixteen, or more, or even several hundred spores in each spore-case. The spores differ greatly in size, form and color. In Theloschistes they are colorless, of an oval form (Fig. 146), with a small cavity at each end, sometimes connected by a small canal, and measure from twelve to sixteen thousandths of a millimetre in length. In other species they are of a brownish yellow, or a deep brown approaching black. The smallest spores are hardly two thousandths of a millimetre in diameter, while the largest are nearly two-tenths of a millimetre in length. In form they are globose, oval, elliptical, fusiform, needle-shaped, etc. (Fig. 147). Many spores are divided by one or more transverse partitions, and these again sometimes by perpendicular ones. The former are called *di-tetra-pleio-*, or poly-blastish; the latter muriform, and spores like those of Physica, polar-bilocular. Their great variety of form and color renders them most interesting objects under the microscope, and they are of

Fig. 148.

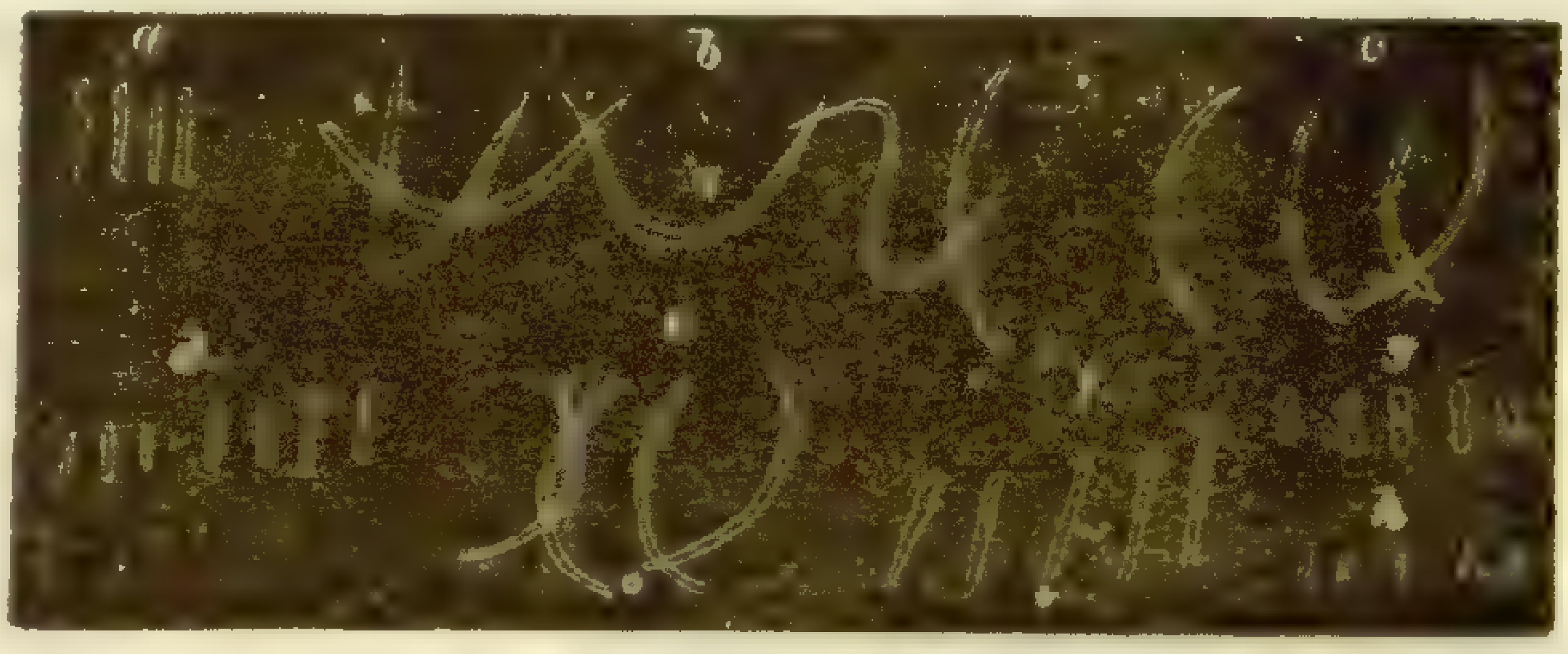
Section of Spermogonea of *Theloschistes parietina*. *cl*, cortical layer; *g*, gonidia; *o*, ostiolum; *c*, cavity; *s*, sterigmata; *ml*, medullary layer.

Fig. 149.

Sterigmata and spermatia of the same.

great importance in the determination of species, so that the study of lichens cannot now be successfully or thoroughly prosecuted without an acquaintance with them. Their general form and color being constant in each genus and species, they have, as Professor Tuckerman observes (Lichens of California), "added a new content to the conception of species." While their study opens fresh difficulties and perplexities to the student, it affords him a deeper insight into the inscrutable mysteries of nature, who, whatever we may strive to ascertain, ever holds some secrets in reserve which are beyond our grasp.

Fig. 150.



Spermatia.

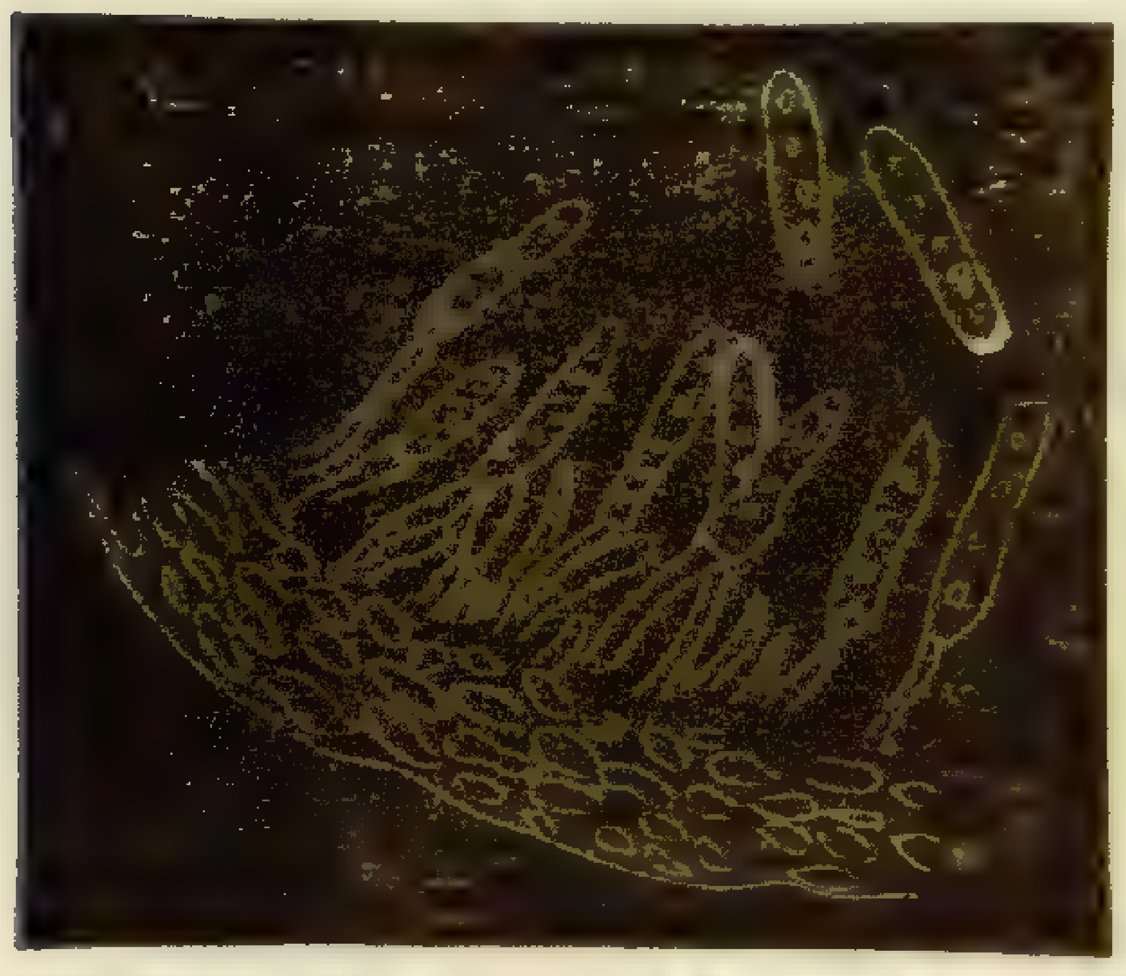
Fig. 151.

Section of pycnide of *Biatora Heeri*. *s*, stylospores; *t*, thallus of *Peltigera canina*.

In its earliest stages the spore-case appears filled with small globular granules, in which lines of division appear, and the spores gradually assume their regular form and number. The spores are at first colorless and simple, and their internal divisions and changes of color may be seen in all gradations in the same hymenium. They frequently remain filled with a mass of oil globules. They are sometimes arranged in a linear

series in the spore-case, sometimes irregularly grouped, and sometimes spirally twisted around a central (ideal) axis. When ripe they are expelled from the spore-case by the pressure of the paraphyses, which when moistened, absorb water copiously. Many observations have been made as to the manner of the development of the thallus from the spore, but the matter is still involved in a good deal of obscurity.

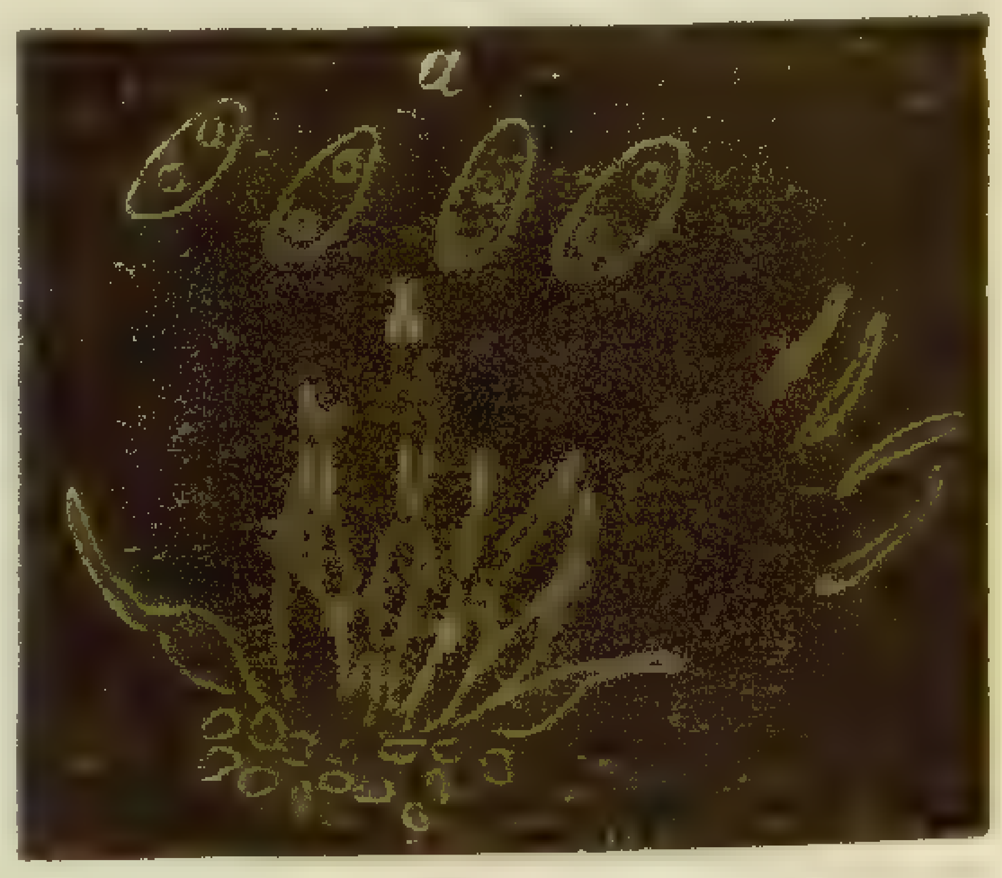
Fig. 152.



Portion of pycnide of *Biatora Heerii* more highly magnified, showing the stylospores.

On the thallus of most lichens are to be seen a number of small black dots, either scattered irregularly over its surface, or along the margin. These are the spermogonea (Fig. 148), and they contain, in great numbers, the spermatia, which are extremely minute, cylindrical, or needle-shaped bodies, situated on the extremities of simple or branched filaments, called sterigmata (Figs. 149, 153). Their forms appear to be constant in each species, but are much less diverse than those of the spores, and they are always colorless. They have been supposed to be the male organ of reproduction, but nothing is certainly known of their functions. Nylander, who attaches much importance to the spermatia in his Synopsis, distinguishes five forms of them. 1st, the acicular slightly swollen at one end, as in Usnea; 2d, acicular slightly swollen near the extremity, as in Evernia; 3d, straight acicular or cylindrical, as in most Lecanoras; 4th, bowed acicular, or cylindrical, as in some Lecanoras; 5th, ellipsoid or oblong, as in Calicium, which last, he says, approach rather too near the short cylindrical spermatia. There are no spherical spermatia. But he is not fortunate in attempting

Fig. 153.



Spores (*a*), sterigmata and spermatia (*b*), of *Biatora Heerii.*

to apply these distinctions, and it seems difficult to render them of any great systematic value. Leighton, who has described and figured the spermatia of a large number of lichens, has failed in many instances to recognize the differences in form indicated by Nylander, especially in regard to the first two forms. and points out a great confusion in the application of Nylander's idea in his Prodromous and Synopsis in regard to the spermatia of Platysma (Cetraria). In figure 150 (*a*, spermatia of *Pyrenula lactea* Mass.; *b*. *Verrucaria epigæa* Pers.; *c*, *Synalissa phylliscina*; *d*, *S. phæococca* Tuck.; *e*, *Lecanora athrocarpa* Duby; *f*, *Parmelia colpodes* Tuck.; *g*, *Cetraria ciliaris* Ach.; *h*, *Placodium camptidium* Tuck.), we give a few additional illustrations of the different forms of spermatia. A slight but distinct crackle is almost invariably heard on crushing the spermogonia under the thin glass, which seems peculiar to these organs. Besides the spermogonia, there are also other small bodies, resembling them in external appearance, called pycnides (Fig. 151), but containing spore-like bodies called stylospores (Fig. 152), on the extremities of short filaments. They are often septate. Their office is unknown, and they are of comparatively infrequent occurrence.

REVIEWS.

The Eared Seals.*—Up to the year 1866, comparatively little attention had been paid to the systematic relations *inter se* of the seals, and in that year, Dr. John Edward Gray, in the "Catalogue of the Seals and Whales in the British Museum," adopted essentially the same classifica-

*On the Eared Seals (*Otariadæ*), with detailed descriptions of the North Pacific species, by J. A. Allen. Together with an account of the habits of the northern fur seal (*Callorhinus ursinus*), by Charles Bryant. [1 pl. 108 pp., 3 pl. 31. exp.] Bulletin of the Museum of Comparative Zoology [etc.]. Vol. II. No. 1.

The copy which we owe to the kindness of the author, is further illustrated by two photographic plates of *Zalophus Gillespii.*

tion which he had presented in 1850, in his catalogue of the seals — a singularly unnatural one, based chiefly on the number and development of the teeth; all the Pinnipeds were regarded as forming a single family, divided among five sub-families, namely: —

A. Grinders two-rooted; [etc.] *
  a. cutting teeth 4 [above]; 4 [below] [etc.] *Stenorhynchina.*
  b. " " 6 [above]; 4 [below] [etc.] *Phocina.*
B. Grinders with single root (except the two hinder grinders of *Halichœrus*).
  c. Ears without any conch; [etc.].
    * Muzzle large, truncated, simple; canines large; grinders lobed, when old, truncated. *Trichechina* (with *Trichecus Rosmarus* and *Halichœrus!*)
    ** Muzzle of the male with a dilatable appendage; cutting teeth 4 [above] 2 [! below]; [etc.] *Cystophorina.*
  d. Ears with a subcylindrical distinct external conch; [etc.] *Arctocephalina.*

* Only the prime contrasted characters are noticed here; the others are often applicable only to a portion of the groups diagnosed.

If classification is really intended to represent the natural relations of organized beings, as determined by the sum of their structural agreements, and the subordination of the respective groups differentiated, a more unfortunate classification than that noticed could scarcely be devised; if even it is only regarded as a means to enable us to ascertain the name of a certain form, it is a decided failure; *i. e. Halichœrus* (of the second prime division), having the "grinders with single root (*except the two hinder*)," not being distinguished, even by Gray's own diagnosis, from *Lobodon* of the *Stenorhynchina* (first prime division), which has only "the first, second, and third front upper grinders single-rooted, [the rest *two hinder*] two-rooted!" Like inconsistencies prevail, but why, in the name of science and common sense may we ask, is *Halichœrus* separated from those forms which it so much resembles, to be combined with the Walrus, to which it is so very unlike, when even a diagnosis has to be explained away to admit of such a freak! The chief modifications in the arrangement of 1866, compared with that of 1850, are the introduction of the genera *Pagomys*, *Halicyon*, (the latter based on intangible characters,) and *Callorhinus*.

In the same year, 1866, appeared a "Prodrome of a Monograph of the Pinnipeds, by Theodore Gill," in the Proceedings of the Essex Institute (V, pp. 1-13), in which those animals were distributed among three families (*Phocidæ*, *Otariidæ*, and *Rosmaridæ*), equivalent to the three sub-families recognized by Turner, and the *Phocidæ* were divided into three sub-families, distinguished by important osteological characteristics previously unnoticed by systematists. In the *Otariidæ*, five genera were recognized, of which the types were the only species mentioned.

This article was rapidly succeeded by a number of memoirs, chiefly on the Otariids, two by Gray and two by Peters being published in the same year. The former, after a first passionate outburst of anger, finally accepted as valid the three families just noted, and, like Peters, adopted the genera of Otariids first defined in the Prodrome (*i. e. Eumetopias* and

Zalophus), raised to generic rank two additional groups named as sub-genera by Peters, and ended by proposing genera for every recognized species of the family, and distributing them among five sub-families. The extreme to which differentiation was carried may be judged from the fact that Mr. Allen has reduced two of his genera to one species, and was strongly inclined to reduce three others to a second species. Those sub-families in the main agreed with the genera defined in the "Prodrome of the Pinnipeds," but were rendered unnatural by the combination — in face of the characters used as diagnostic — of *Arctophoca* (a sub-division of *Arctocephalus*) with *Eumetopias*, and by the association of *Phocarctos* (a form inseparable from *Otaria*) in the "*Arctocephalina*." As an example of the mode of differentiation, the following diagnoses will suffice.

"*Zalophus*. Grinders large and thick, in a close uniform series. South America."

"*Nerphoca*. Grinders large, thick, all equal, in a continuous uniform series. Australia."

As will be perceived, the same feature is indicated simply by a slightly different phraseology, save as to the locality. But even the alleged character of locality is erroneous, for *Zalophus* has never been found in South America, and its type is an inhabitant of the North Pacific only, *i. e.* California and Japan!

The chief and most valuable information published after the "Prodrome," and up to the year 1870, was contributed by Dr. Wilhelm Peters, and to that accomplished zoologist we are indebted for the first reliable coördination of external and osteological characters — a task that was found to be impossible with the material possessed by the author of the "Prodrome."

Much information had also accumulated as to the distribution, habits, and external characteristics of the various species of *Otariidæ*, and excellent figures of the skulls of several species had been published. It was with these additional facilities that Mr. J. A. Allen proceeded to the investigation of the North Pacific species of the family, and incidentally of the classification of the entire group. He has, like his immediate predecessors, admitted the validity of the family called by him "*Otariadæ*," and has admirably contrasted the characteristics of the pelvis and hind limbs of those animals, with the corresponding parts of the Phocids; the species of Otariids are distributed among five genera corresponding to those established in the "Prodrome," and of which our author remarks that "these appear to be natural groups, of true generic rank, and properly restricted; and, after a careful examination of the subject, ... they appear to [him] to include all the natural genera of the family." *

These five genera are considered by Mr. Allen as separable among two sub-families, the author remarking (p. 22) "that if the *Otariadæ* constitute a group entitled to family rank, — and the so-called sub-families of the

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* Allen, op. cit., p. 38.

Phocidæ have truly a sub-family value, — the *Otariadæ* must be considered as divisible into two sub-family groups, of which the hair seals constitute one and the fur seals the other." Reviewing the previous sub-divisions into tribes or sub-families by Gray, and the misappropriation of sub-family names derived from the typical genera, he adds that in view of this confusion the name *Trichophocinæ* * is proposed for the hair seals, and *Oulophocinæ* † for the fur seals, in allusion to the different character of the pelage in the two groups." To the *Trichophocinæ*, are referred the genera *Otaria*, *Eumetopias*, and *Zalophus*; to the *Oulophocinæ*, the genera *Arctocephalus* and *Callorhinus*.

Mr. Allen has derived the characters for his sub-families, solely from the nature of the pelage, the size and form of the entire animal, the length of the ears, the length of the toe-flaps of the hinder limbs, and the number of molars. His definitions are as follows: —

"Sub-family I. *Trichophocinæ*.

Without under-fur; size large and form robust; ears short and broad; molars either 6 [above] 5 [below] 5 [above] 5 [below]=12 [above] 10 [below] or 5 [above] 5 [below] =10 [above] 10 [below]."

"Sub-family II. *Oulophocinæ*.

With thick under-fur; size smaller; form more slender, and the ears and the toe-flaps of the hinder limbs much longer than in *Trichophocinæ*; molars 6 [above] 5 [below] 6 [above] 5 [below]=12 [above] 10 [below]." (Allen l. c., 44.)

We may at once concede the applicability of the distinctions based on the pelage, remarking, however, that the character is not as absolute as might be inferred from the expressions used, for in the hair seals there is the homologue of the under-fur of the fur-seals, and Gray attributes to *Zalophus cinereus*, "young covered with *soft fur*, which falls off when the next coat of fur [hair] is developed." Peters also found a considerable difference in the extent of the under fur in the species of *Arctocephalus*, *A. antarctica* (*Otaria pusilla* Peters) having very thin under hair ("Mit sehr sparsamer Unterwolle"); *A. cinerea*, thicker under-hair ("Mit reichlicherer Unterwolle"), and *A. Falklandica* also thick under-hair ("Haar mit dichter Unterwolle"); the difference between the extremes of those two groups seems thus to be very much reduced, when we take all into consideration.

As to size, the difference seems to be more than reduced to a minimum, and to be degraded to absolute nullity. The length of the skull is the most constant meter, and the following measurements, to all of which Mr. Allen had access, will demonstrate the truth of our criticism. We have in every case taken the measurement of the adult males only, and have reduced all the measurements to millimetres.

1.	Arctocephalus nigrescens,	203	Gray.
2.	" Falklandicus,	235	Peters.
3.	Callorhinus ursinus,	237	Gray.

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* θριζ, hair, and φώκη, seal.

† Οὐλος, soft, and φώκη.

4.	Otaria Ulloæ,	238	Peters.
5.	Callorhinus ursinus,	245	Allen.
6.	Arctocephalus antarcticus,	262	Gray.
7.	Zalophus Gillespii (Japonica),	270	Peters.
8.	Callorhinus ursinus,	275	Allen.
9.	Zalophus Gillespii,	279	Gray.
10.	" "	290	Allen.
11.	Otaria Godeffroyi,	300	Peters.
12.	Zalophus Gillespii (Japonica),	310	Peters.
13.	" "	330	Allen.
14.	Otaria jubata,	335	Gray.
15.	Eumetopias Stelleri,	355	Gray.
16.	" "	374	Allen.
17.	" "	385	Allen.

As it may be objected that the skull of *Otaria Ulloœ* was of a female or young, we will at once dismiss that from consideration. But the forms still remaining, and concerning which no objection, it appears to us, can be urged, demonstrate that there is not only no constant difference, but that members of the respective groups traverse the limits assigned thereto, some individuals of *Oulophocinœ* being larger than some individuals of the *Trichophocinœ*, *Zalophus* being admitted as one of the latter. It is further to be added that the "form more slender" of the former, implies a greater relative total length for those animals than the head alone would indicate, and thus the inapplicability of the diagnosis is still further enhanced.

As to the character derived from the comparative robustness or slenderness, the following measurements by Mr. Allen, of the hair and fur seals of Alaska, show the following proportions:*—

	Unmounted.	Mounted	Skull.	Ratio of skull to length of male skin.
Callorhinus ursinus (2,923),		2,470	245	I.–X. 20-245
" " (2,922),	2,311	2,390	275	I.–VIII. 190-275
Eumetopias Stelleri (2,920),	2,750	2,790	374	I.–VII. 300-374
" " (2,921),	2,896	3,010	385	I.–VII. 315-385

When we thus become cognizant of the comparatively slight differences between the two members of the family observed, when too, we notice the range of variations in one of the species, and when we reflect that such difference may be created by the mode of preparation of skins, and that other forms appear to be intermediate, to say the least, the character becomes very intangible.

The length of the ears is the next character noticed; the following measurements will illustrate the relative lengths in millimetres.

Otaria,	15-20	Peters.	Eumetopias,	35-37	Allen.
Zalophus,	15-20?	Peters.	Arctocephalus,	30-40	Peters.
Eumetopias,	30	Peters.	Callorhinus,	35-50	Allen.

These measurements, by Mr. Allen, are from the *same individuals*, before

* No data are given concerning the ratio of the girth to the length, and no very appreciable and constant differences appear to exist, although there is said to be considerable difference in such respects in the same individual at different seasons.

and after mounting, the ears appearing shorter when mounted. We thus learn at once to distrust and be cautious respecting such characters, even admitting their value. But in view of these tables, and the conclusions we have already reached concerning the size, we are compelled to ask, where are the differences — even proportionate? Be it remembered that no differences of form have been referred to, nor has the reviewer by autopsy been able to convince himself of the existence of any of moment.

One other character remains; in *Oulophocinæ* "the toe-flaps of the hinder limbs much longer than in *Trichophocinæ*." The statement is perfectly applicable, whatever may be our estimate of its value, if only *Callorhinus* and *Eumetopias* are taken into consideration, but *Otaria* itself offers an intermediate condition. There is no difference claimed as to dentition, as the alternatives for the *Trichophocinæ* indicate.

Mr. Allen, we trust, will pardon us, in view of the facts now made prominent, if we refuse to consider the alleged differences as indicative of sub-family value, if only for the reason that they are not trenchant; but we must add that even had they been absolute, we should have been extremely doubtful as to the propriety of assigning them such a taxonomic value.

But if we have been obliged — and most unwillingly we have — to dissent from Mr. Allen in his view of taxonomic values, we rejoice to testify to our concurrence with him in the main, and if Mr. Allen will simply reject *Zalophus* from the company of the other hair seals, we will at once admit that he has made an important advance in the appreciation of the relations, *inter se*, of the members of the family; the comparative relation between *Otaria* and *Eumetopias* appears indeed to be more intimate than previous observers had suspected, and equally intimate as contrasted with those just named is the relationship between the genera of the fur seals. But between both forms and *Zalophus*, the hiatus appears to be almost equally wide and impassable, although perhaps less between it and the typical hair seals. If any prime sub-division of the Otariids is to be made, and if the skull is a correct index, it should, in our judgment, be made into one group, composed of all its members save *Zalophus*, while that group should be isolated afar. All the species, except of that genus, agree in having a more or less decurved and swollen muzzle, and a deep sagittal seam, or groove, between the low ridges indicating the limits of the muscular attachments. *Zalophus*, on the contrary, has a narrow and regularly attenuated muzzle, which is straight or even slightly concave, and instead of a sagittal seam has a much elevated and trenchant crest; these characters are supported by peculiarities of the post-orbital lobes, the nasal channel, the sinus of the bony palate, the pterygoid hamuli, and the dentition. *Zalophus*, as Mr. Allen has well remarked, "so far as the skull is concerned, is the most distinct generic form of the *Otariadæ*, it being thoroughly distinct from all the others" (p. 68). We may add that we know of no indications, from other sources, which belie

this evidence of isolation. But while we would thus insist on the isolation of *Zalophus*, we would not consider it as entitled to rank other than as an aberrant genus (*i.e.* in comparison with the more numerous existing forms) of a homogeneous family. Far different, in our opinion, are the relations between the members of that family and the groups which have been distinguished as sub-families in the Phocids,* and which we are happy to learn meet with Mr. Allen's approbation.

Availing ourselves now of the data that have accumulated up to the present time, and which have been so well digested by Mr. Allen, we believe that the relations of the Otariids may be expressed by the following synoptical table, in which only the most obvious and distinctive characters are introduced.

I. Skull with a more or less decurved front rostral profile, and with a sagittal groove from which are reflected the low ridges indicating the limits of the temporal muscles.
- A. Pelage with under-fur: molars normally 6 [above] 5 [below] 6 [above] 5 [below]; hinder feet with swimming membranes produced much beyond the toes, and moderately incised.
  - a. Snout much decurved above, and abbreviated, its length being less than the longitudinal diameter of the orbits. *Callorhinus.*
  - b. Snout moderately declining above, and moderate in length, exceeding the longitudinal diameter of the orbit, . . . *Arctocephalus.*
- B. Pelage without defined under-fur.
  - *a*. Molars above 6-6; the last little remote from the preceding and in a line with, or in advance of the transverse maxillo-palatine suture; bony palatal margin much nearer the pterygoid hamuli than the teeth; hinder feet with swimming membrane much produced and deeply incised, . . . *Otaria.*
  - *b*. Molars above 5-5; the last remote from the preceding, and behind the transverse maxillo-palatine suture; bony palatal margin nearer to teeth than to pterygoid hamuli; hinder feet with swimming membrane produced little beyond the toes and moderately incised, ... *Eumetopias.*

II. Skull with a straight or incurved fronto rostral profile, and with a solid, thin, and much elevated sagittal crest, ... *Zalophus.*

Although we are not inclined to place much stress on the sequence of forms when so many gaps remain unfilled, and when the unknown might reverse the opinion that we have with more or less reason derived from some acquaintance with the seen, we are disposed to believe that the preceding approximates correctness, and to believe that *Zalophus* is the most generalized form, *Eumetopias* next, and *Callorhinus* the most specialized. If it were absolutely necessary to express the various categories of subordination by names, we would have to designate I. and II. as contrasted, and then I. (A). and I. (B). as representing a nearer degree of relationship, but such a system, especially when the genera are very numerous, becomes too complicated, and is of really little or no use. We

* These sub-families, though bearing the same name as Dr. Gray imposed on artificial groups, are entirely differently limited.

do not speak of taxes on the memory, for memory has nothing to do with the existence of natural groups, although some persons are in the habit of objecting to names because, forsooth, they tax the memory.

With respect to species, Mr. Allen carries conservatism to an extreme. In the case of doubtful species — at least of those which have tangible characters, but the value of which may be dubious — some naturalists refer such at once to species which they appear, in their judgment, to most resemble, while others — probably most—retain them with reserve, awaiting future information. Of the former school Mr. Allen is an ardent disciple, and finding a certain range of variation in some known form, he concludes that analogous variations are only of like value; the inference is by no means a perfectly safe one, though it may be best in *proposing* specific names, to be somewhat influenced thereby. In the present family, at least ten species have been admitted by one of the most accomplished and judicious naturalists (Professor Peters) of Europe, after autopsy. Three such species are considered by Mr. Allen, who had never seen them and was only guided by analogy, as variations of one; *Otaria jubata*, *O. Ulloæ*, and *O.* (*Phocarctos*) *Hookeri*,* being referred to *O. jubata* extended; and three other species unhesitatingly admitted by those who have examined them, are admitted as very doubtful, *i. e.*, *Arctocephalus Falklandicus*, *A. cinereus* (Gray), and *A. antarcticus*. It may be that Mr. Allen is correct; there are doubtless reasons for his belief, but, in our judgment, the interests of science are better subserved by retaining the doubtful forms as distinct, till observation has demonstrated their character; by retaining them as distinct, an incitement is furnished to their collection and investigation, while if they are merged as synonymous with others, their identity is lost; it is assumed that their degradation was correct, and if finally proved to be distinct, it has too often happened that they have been re-introduced into the system under new names, the recollection of their former distinction having been lost, and thence it is that in after years the nomenclature is again disturbed by the revival of the unjustly buried names. It is to be feared that some of the species which Mr. Allen has doomed to annihilation will yet arise and assume a healthy stability.

A few words as to the relations of the family. Mr. Allen, treating of the primary groups of the Pinnipeds, remarks (p. 21), that "believing that they have a higher value than a sub-family value, I adopt for the present the classification elaborated by Dr. Gill, in his Prodrome, which is, it seems to me, the most natural arrangement of the Pinnipeds that has been proposed. Gill's arrangement places the *Otariadæ* between the *Phocidæ* and *Rosmaridæ*.* The *Otariadæ* are evidently the highest, though they seem intermediate in general features between the earless seals and

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* Since the transmission to the printer of the copy of this review, a number of the "Anales del Museo publico de Buenos Aires" has come to hand in which the discovery of the *O. Hookeri* at the mouth of the Rio Parana (op. cit. I. 461) is announced.

the walruses. Their affinities, as they appear to me, may be indicated as follows: —

OTARIADÆ,

"ROSMARIDÆ,

PHOCIDÆ.

"The evidences of the superiority of the *Otariadæ* over the *Phocidæ*, consist mainly in that modification of their general structure, and especially of the pelvis and posterior extremities, by means of which they have freer use of their limbs, and are able to move on land with considerable rapidity; the *Phocidæ*, on the other hand, move with great difficulty when out of the water. But the higher rank of the former is also indicated by their semi-terrestrial habits, the scrotal position of the testes, and in the nearer approach in general features to the terrestrial Carnivores, especially in the more posterior position of the acetabula. Most of these modifications are, however, nearly equally shared by the *Rosmaridæ*, indicating, likewise, that their true position is above that of the majority of the *Phocidæ*."

Like considerations of structure induced the author of the "Prodrome" to adopt the arrangement commended, but without reference to that metaphysical rank to which Mr. Allen seems to refer. High and low in zoology are often very ambiguous terms. So far as Mr. Allen means the generalized, by high, and by lower, the more modified types, we perfectly agree with him, for the Otariids seem indubitably to be the least removed in structure from that stock which has diverged from the old feral stem and culminated into the existing Pennipeds; nearly equally plain does the evidence appear that the Walrus is in general a type which possesses more of the primitive characters of the stock than do the Phocids, although it exhibits some remarkable teleological adaptations. But such a connection of the term high would indicate a belief in progressive degradation — a Hibernicism which we are probably not the first to use. Even in this sense, as an abstract question, we have no objection to the employment of the term low, for there seem to be too many proofs of the existence of such cases to doubt. But Mr. Allen leaves us in uncertainty as to whether he shares with the few scientists a belief in metaphysical species and subordination, or, with the many, interprets appearances as indicative of facts. In the former case there would be no basis for argument, but if we still call low, in comparison with the gressorial carnivores, the Pinnipeds and the whales, believing in their evolution from the same stock as the former, it is only because we connect, with adaptation for aquatic life, the idea of degradation. How far this may be correct, we are not at present called upon to discuss. It may be here stated that if the author of the "Prodrome," in a treatise on the Pinnipeds alone, placed the Otariids in the middle, because they were the most generalized, and the other types departed therefrom in different directions, he would not feel barred, in a general scheme of the mammals, from placing them, for the same reason, next to the still more generalized group

In this connection it may be recalled that while in the monogamous Pinnipeds, or those living in small communities, there is little difference in size between the males and females, in the social species, or rather those of which the males have harems, the males are vastly larger than the females. *Macrorhinus*, of the Phocids, and all the Otariids belong to the latter category. The difference between the sexes would be readily explained by Mr. Darwin on the principle of natural selection. It is evident that the larger and more vigorous males would be the eventual possessors of the females, and the disproportion of the sexes would in lapse of time culminate, till it had reached a proportion when obvious mechanical difficulties would more than balance the advantages resulting from superior size and vigor, and when, therefore, farther disproportion would be arrested. It may be added that the like disproportion of the sexes in the forms above enumerated, furnishes not the slightest evidence of more intimate primordial affinity, for like causes would in each special case, such as this, produce like effects.

We have already lingered so long over the systematic portion of Mr. Allen's work that we are perforce obliged to omit any observations on the habits or physiological relations of the species, but the work is replete with information on the subject contributed by Captain Bryant respecting the fur-seal (*Callorhinus ursinus*), and judiciously edited, with notes and comparisons with the habits of other members of the family, by Mr. Allen.

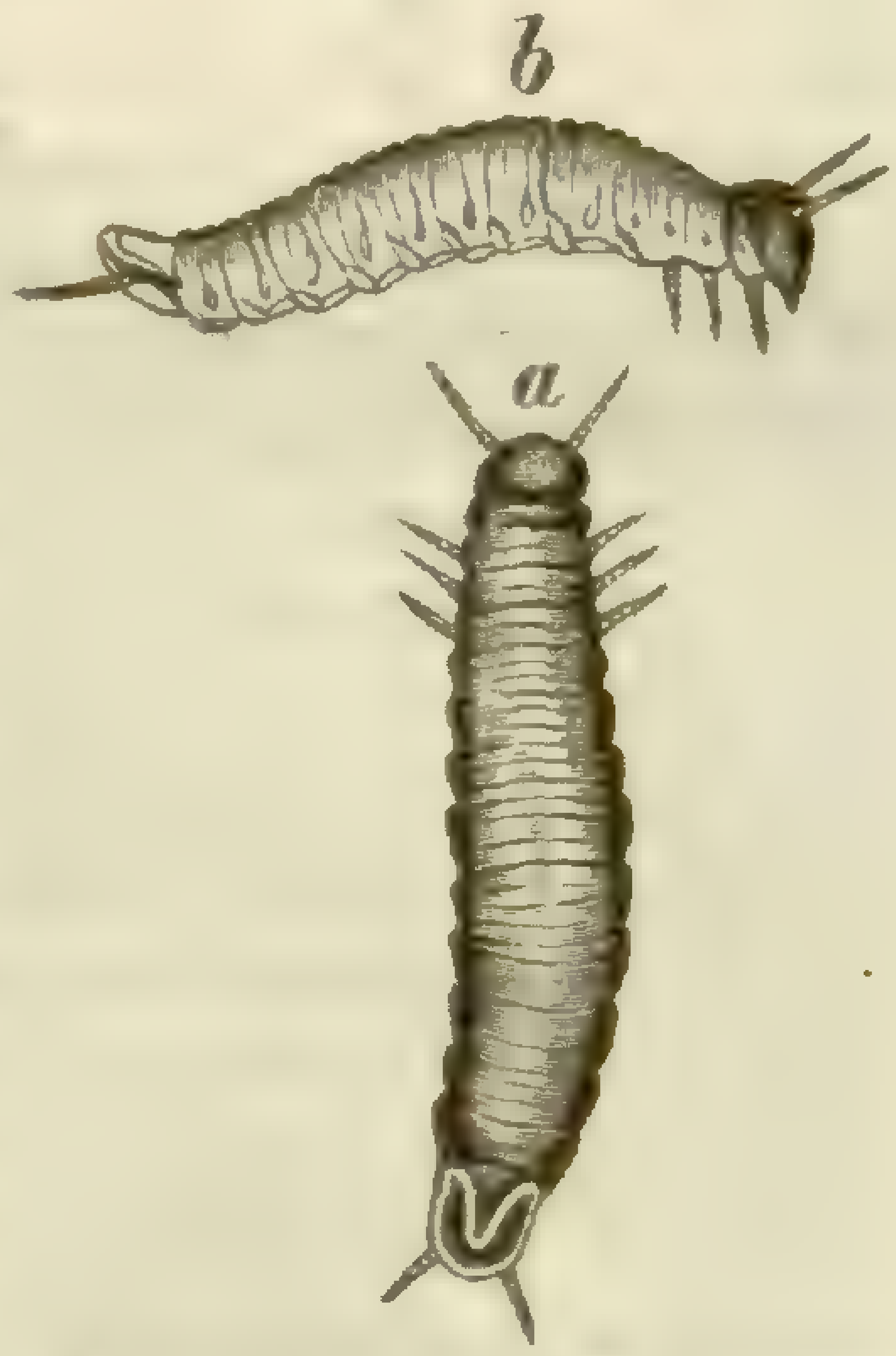
And finally, cordially thanking Mr. Allen for his most valuable contribution, and the Museum of Comparative Zoology, under Professor Agassiz's superintendence, for its publication, we close by a recapitulation of its most noteworthy elements, namely: — A nearly complete rèsumè of the later literature on the subject, and discussion of the value of the respective contributions, enabling him who would follow up the investigation to refer at once to the proper authorities; an excellent contrast of the skeletal characters of the Otariids and Phocids; a coördination of external and internal characters for the genera, and the approximation of the related genera; detailed descriptions and measurements of the Alaskan species; and, finally, in company with Captain Bryant, copious information respecting their habits, and comparison thereof with those of other species. — THEODORE GILL.

INJURIOUS INSECTS.* — In this contribution to applied entomology, we find new observations relating to insects injuring the apple-tree, cherry, cranberry vine, currant, raspberry, oak, pine, certain ornamental shrubs, garden vegetables and hot-house plants. The apple-bud moth (*Grapholitha oculina*), so injurious in Eastern New England, is described. The larva is a little brown caterpillar which eats the buds in May. It is difficult to kill it without also injuring the tree itself. It also injures the buds

* Injurious Insects, New and Little Known. By A. S. Packard, Jr., M. D. [From the Massachusetts Agricultural Report, 1870.] 8vo, pp. 31. With a plate and wood-cuts.

and crumples the leaves of the cherry, and especially the pear. A minute moth is also described as mining the leaves of the apple, a single leaf sometimes containing five or six larvæ. It is a Micropteryx (*M. pomivorella* n. sp.), allied to the European *M. calthella*, though about half its size. This is the only species of this interesting genus yet found in America. Of the two moths infesting the cherry, the v-marked tortrix (*Tortrix V-signatana* n. sp.) has been raised from the cherry by Mr. F. W. Putnam. The other is a beautiful Coleophora (*C. cerasivorella* n. sp.). Four insects infesting the cranberry vines are mentioned. One of these is the yellow cranberry worm (*Tortrix vacciniivorana* n. sp.), of the New Jersey cranberry fields, while the habits of the cranberry weevil (Pl. 6, fig. 10, enlarged; 10*a*, larva, enlarged), are described from the observations of Mr. W. C. Fish, who has paid more attention than any one else to the insects infesting the cranberry. Two insects not before known to feed on the currant, are the *Chœrodes transversata* of Walker, and *Halia wavaria*, a species introduced from Europe, where it has long been known to feed on the gooseberry.

Fig. 154.



Larva of a species of Lyda.

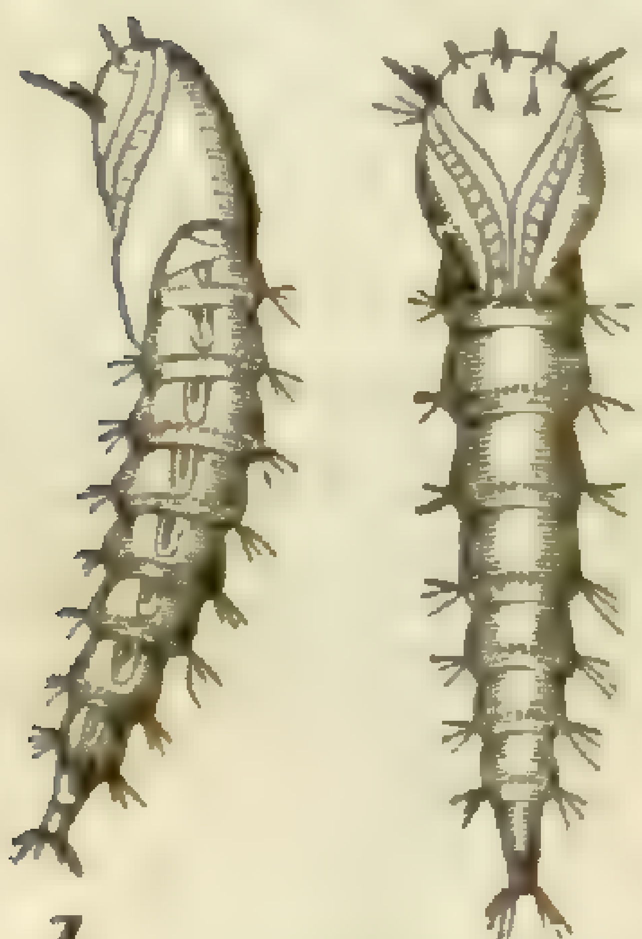
The raspberry is attacked by a beetle (*Byturus unicolor* Say, Pl. 6, fig. 12, enlarged), which eats the fruit buds, and makes long slits in the leaves during June. Of forest insects, the many-teethed Priocycla (*P. bilinearia* n. sp.), is a span worm feeding on the oak. The pine Paraphia (*P. piniata* n. sp.); the pine Zerene (*Z. piniaria* n. sp.), and pine Parennomos (*P. piniata* n. sp.), have been found feeding on the pine in Canada by Mr. W. Saunders, to whom our entomologists are much indebted, among other articles, for his descriptions of the larvæ of many of our butterflies and moths. Besides these pine insects, the singular saw-fly larva of a species of Lyda (Fig. 154), which has been found on the Austrian pine in a garden in Salem, deserves mention. It is a reddish olive green worm, with a pale reddish head, and two appendages to the end of the body like its antennæ.

A species of the Snout moth, of the genus Botys (*B. syringicola* n. sp.) has been found by Mr. Angus of New York, boring the pith of lilac bushes, and it is stated in this connection that Mr. Angus has also found a clear winged moth (*Ægeria syringæ* Harris) to be often destructive to lilacs.

Of interest to gardeners is an account of the bean weevil (*Bruchus granarius* of Linnæus, Pl. 6, fig. 8, bean containing several grubs: 8*a*, pupa). This is the well known and very destructive bean weevil of Europe, concerning which Mr. Angus writes from West Farms, N. Y., to the author: "I send you a sample of beans which I think will startle you

if you have not seen such before. I discovered this beetle in the kidney or bush beans a few years ago, and they have been greatly on the increase every year since. I might say much on the gloomy prospect before us in the cultivation of this important garden and farm product if the work of this insect is not cut short by some means or other. The pea Bruchus is bad enough, but this is worse."

Fig. 155.



Pupa of Robber-fly.

Another insect is brought to the notice of farmers, the corn Sphenophorus (*S. zeæ* Walsh, Pl. 6, fig. 11), of which Mr. R Howell of Tioga County, New York, writes June 14, 1869: "This is the fourth year they have infested the newly planted corn in this vicinity. The enclosed specimens were taken on the 11th instant. I presume that they have been in every hill of corn in my field. They pierce the young corn in numerous places, so that each blade has from one to six or eight holes of the size of a pin, or larger, and I found a number last Friday about an inch under ground hanging to young stalks with much tenacity. When very numerous every stalk is killed. Some fields two or three years ago were wholly destroyed by this insect. The habits of a robber-fly (*Proctacanthus Philadelphicus* fig. 155, pupa), which burrows in the sand of the shores of Plum Island, Mass., are noticed, together with those of the large horse fly (*Tabanus atratus*, fig. 156, pupa), which in its early stages lives in garden mould. Among plant house insects is noticed the white scale bark louse (*Aspidiotus bromeliæ*, Pl. 6, fig. 6, magnified; 4, young magnified; 4*a*, end of body still more enlarged). It is often destroyed by a minute chalchid fly, Coccophagus(?). Boisduval's fern bark louse (*Lecanium filicum* Pl. 6, fig. 7*a*, scale enlarged seen from above; 7*b*, the same, seen from beneath, and showing the form of the body surrounded by the broad flat edge of the scale; 7*c*, an antenna, enlarged; 7*d*, a leg, enlarged; 7*e*, end of the body, showing the flattened hairs fringing the edge), is common on hot-house plants, as also the Platycerium bark louse (*Lecanium platycerii* n. sp. Pl. 6, fig. 5, magnified; 5*a*, an antenna enlarged). and the plant house coccus (*C. adonidum* Pl. 6, fig. 3, magnified); the plant house aleurodes (*A. vaporarium* of Westwood, Pl. 6 fig. 9, enlarged; 9*a*, pupa enlarged), is more common perhaps than one would suppose. It lives out of doors on tomato leaves and we found it not uncommon. in September, on strawberry plants on the grounds of the State Agricultural College, at Amherst. The list of hot-house insects is completed by one of the most injurious of all, the minute thrips (*Heliothrips hæmorrhoidalis*), from Europe, Pl. 6, fig. 2, greatly magnified, which by its punctures, causes the surface of the leaf affected to turn red or white, while at times the entire leaf withers.

Fig. 156.

Pupa of Horse-fly.

PACKARD, ON INJURIOUS INSECTS.

NATURAL HISTORY MISCELLANY.

BOTANY.

Fertilization of Salvia by Humble Bees. — Mr. Meehan's statements "On Objections to Darwin's Theory of Fertilization through Insect Agency," at the late meeting of the American Association for the Advancement of Science, an abstract of which is given in the October Number of the American Naturalist, are at such variance with my own observations on the same subject, that I cannot allow them to pass unchallenged. Mr. Meehan affirms that the humble bee does not enter the corolla of the Salvia to obtain the honey, but "bores a hole on the outside" for that purpose. He says, after describing the structure of the flower — "The principle is perfect. *But no insect is seen to enter.*" This statement is certainly not in accordance with facts. I have again and again observed the conduct of the humble bee on the Salvia; and I affirm that a large majority of the bees *do* enter the corolla, and that the anthers rest on the back of the insect exactly in the way that Mr. Meehan says they ought to rest. It is true that some of the bees do cut the tube of the corolla to get the honey. This, however, is only done by those bees which are *too large* to get into the flower. — E. H. T., *Hindsbury, Delaware Co., Penn., Oct.* 15, 1870.

Motion in the Leaves of Rhus toxicodendron. — Botanical writers tell us that sections of a leaf of *Schinus molle*, thrown in water, have a peculiar jerking motion. Under the name of "Australian Myrtle," I have received seeds from California, which prove to be this plant. The leaves have the motions described. I thought perhaps our own representatives of this order (*Anacardiaceæ*) might present the same phenomenon. I find that this is the case with *Rhus toxicodendron*. Small sections of a leaf leap about in water, but not with the same force as do those of the *Schinus* *Rhus aromatica* though so nearly allied, presents, *to me*, no motion. I have tried *Rhus glabra*, *R. copallina* and *R. typhina*, but find no motion in any but in the one before named — the common "poisoning." A friend to whom I have suggested it, however, tells me that his gardener finds that at "some hour in the day" these also will leap about. The *Schinus* and *Rhus toxicodendron* with me exhibit their saltatorial feats at any and all times. — Thomas Meehan.

Bur Grass. — I enclose a plant that is very annoying to farmers on the eastern shore of Maryland. I am not botanist enough to determine its place. The natives call it "Sand Burr." Will you be kind enough to say something in the Naturalist about it? — John W. Nott.

[Cenchrus, Hedge-hog or Bur-grass, is peculiar for a general resemblance to our Couch or Quitch-grass, and in its habits is equally regarded

with aversion by the farmers. But this latter is a Northern grass, not found at the South, while the Bur-grass is to be found only beyond the limits of New England; according to Dr. Lapham, from Wisconsin to Minnesota; and in the Middle and Southern States, according to other observers. The specimen sent to us by Mr. Nott is *C. echinatus* Muhlenburg (*Descriptio Uberior Graminum*, p. 51) and figured by Plunkenet (*Phytographia* tab. 92–3). It is described by Dr. Chapman in his "Flora of the Southern United States," p. 578; and another species, the *C. tribuloides*, which grows on the seashores of Delaware, Carolina, etc., known as the Cockspur or Bur-grass, is also familiar to farmers, and much dreaded. As much as we detest the Couch-grass of our northern farms, we are to rejoice in the absence of these spiny and thorny spiked and burred-grasses in our northern soils. In some sections where the land is light, the Couch-grass makes a nutritious fodder and hay, being freely eaten by horses and cows; but we suspect that these sagacious animals would not care to digest the flowers and seeds of the "Sand Burr," although the leaves and stems of *C. echinatus* appear tender and abundant, and we can easily understand that it is very annoying where it naturally grows. — J. L. Russell.]

Wolffia in Blossom. — I have just found (August 28th, 1870) the *Wolffia Columbiana* Karsten, flowering abundantly in a pool at Sandwich, Ontario, on the Detroit River. I enclose specimens. I discovered this station for it more than a year ago; but hitherto have failed to find the flowers till now. Untold millions of these tiny plants covered the surface of the water hiding it completely, and lying *en masse*, at least three-quarters of an inch thick. We find it, also (though not fertile), some miles higher up the river, at Connor's Creek, Michigan, but nowhere else along the shores. Though Gray says "flowers and fruit not seen," it has, I think, been found once in flower in the Catskills. The delicate white flowers disappear soon after taking it from the water; but on placing some, next day, in my aquarium, the little plants at once "righted themselves," and the flowers almost instantly reappeared, expanding fresh as ever from the centre of the frond. Last year, in the same pool, it was quite abundant, growing with *Lemna minor* L., which was, however, largely in the majority. Now, I find the Wolffia has almost taken possession of the pool, driving out the Lemna, which is "few and far between," and of a sickly, degraded type. — Henry Gillman, *Detroit, Michigan.*

ZOOLOGY.

Abdominal Sense-organs in a Fly. — While engaged in naming a collection of microscopic preparations of insects mounted on slides by Mr. T. W. Starr of Philadelphia, for the collection of Dr. T. D'Oremieulx of New York, my attention was drawn to a sense-organ situated on the female anal appendages of a species of Chrysopila, allied to *C. ornata*

(Say), a genus of flies allied closely to Leptis. The female appendages are rounded, somewhat spatulate, and of the usual form seen in other species of the genus. The appendage is covered with stiff coarse hairs, about fifty in number, arising from conspicuous, round, clear cells, while the whole surface, as seen under a Zentmayer's 4-10 (A eye-piece), is densely covered with minute short hairs. On the posterior edge of the *upper* side of each appendage is situated a single, large round sac, with the edge quite regular. Its diameter is equal to a third of the length of the appendage on which it is situated. Dense fine hairs, like those covering the appendage, project inwards from its edge. The bottom of this shallow pit is a clear transparent membrane not bearing any hairs. There are no special sense-organs on the antennæ of the same insect.

With these organs, which I suppose to be olfactory in their function, may be compared a very similar single sac situated on the *under* side of the end of the labial and maxillary palpi of a species of Perla, mounted on a slide in the same collection. Its diameter is nearly half as great as the palpal joint itself. Instead of being depressed, the sac in Perla is a little raised, forming a slightly marked, flat tubercle, which is round, slightly ovate, under a 4-10 objective. The surface of the membrane (tympanule of Lespès) is naked. It is strongly probable that this is an olfactory organ, and placed on the under side of the palpi, next to the mouth, so as to enable the insect to select its proper food by its odor, giving an additional sensory function to the palpi of insects. There are no special sense-organs in the antennæ.

Lespès in his note on the auditory sacs, which he says are found in the antennæ of nearly all insects, states that as we have in insects compound eyes, so we have *compound ears.* I might add that in the abdominal appendages of the cockroach we apparently have a *compound nose.* In the palpi of Perla, and the abdominal appendages of Chrysopila the "nose" is simple.

On examination, I have found sense-organs in both pairs of antennæ of *Homarus Americanus*, the Lobster, such as are described by Farre, and also the more rudimentary form of supposed auditory organs in the common spiny Lobster (*Palinurus*) of Key West, Florida. — A. S. P., *Nov.* 30.

NOTE ON THE EXISTENCE OF TRANSVERSELY STRIATED MUSCULAR FIBRES IN ACMÆA.— While engaged in the examination of the lingual ribbon of a species of Acmæa (*A.* (*Collisella*) *Bickmorii D.*), brought from Amboyna by Mr. Bickmore, I noticed that, among the fibres adhering to the ribbon, were several longer than the rest and presenting a different appearance. On submitting them to a high power, it was at once evident that this difference in their appearance was due to distinct, well-marked, though exceedingly fine, transverse striæ. The structure of the fibre itself was a simple transparent tube or cylinder with nuclei irregularly disposed at intervals more or less distant. Upon closer examination of other specimens the striated muscles were determined to be the *retractores radulæ*, or the principal, if not the only agents in pulling back

the ribbon. They were evidently voluntary muscles acting with considerable rapidity. It was noticeable that, of all the muscles of the buccal mass, these only exhibited striation. They differed from some of the dorsal muscles of a small shrimp (*Palæmon* sp.), in being more finely striated. I have had no opportunity, as yet, of examining other species, and therefore cannot say whether the phenomenon is constant throughout the genus. This is the fourth class of the Mollusca, including the Molluscoidea, in which striated muscular fibre has been shown to exist; it has been demonstrated in *Polyzoa* (*Eschara*) by Milne-Edwards; in *Conchifera* (*Pecten*) by Lebert; in *Ascidia* (*Salpa* and *Appendicularia*) by Eschricht and Moss; and finally in *Gasteropoda* in the present case. — W. H. Dall.

Cedar Bird with Waxen Appendages on the Tail. — I have not seen it mentioned in any work, nor do I think that many are aware that the Cedar bird (*Ampelis cedrorum* Baird) is occasionally, though very rarely, found with the tail decorated with those singular wax-like, really horny tips, which it is well known adorn the wings. I have recently been shown a specimen taken in New York State in which the four middle tail-feathers were heavily tipped with this red wax. I have heard of three other cases in which this occurred, though not so strongly developed. I believe that this beautiful ornament, which is never found in immature specimens, does not appear on the wings till the third year. And it is probable that the tail is not so decorated till a much later period. The specimens here mentioned gave evidence of being unusually old birds. — Henry Gillman, *Detroit, Michigan.*

Habits of the Red-headed Woodpecker. — In the spring of 1869 some *Melanerpes erythrocephalus*, began pecking a hole for a nesting place, at about sixty-eight feet from the ground, in the steeple of one of the churches that is situated in our village. One of our citizens, Mr. J. C. Gibson, in order to put a stop to their operations and prevent the farther disfiguration of the edifice, undertook to kill all the birds he saw engaged in pecking at the hole thus commenced; he kept up his deadly assaults upon them until this spring, when his absence from home stopped his attacks upon them; he informs me that he killed in all twenty-two or twenty-three birds that had been engaged in the work; during his absence a pair took possession of the unfinished work, completed the nest, and are now engaged in rearing a brood in it. Is not such persistency of purpose worthy of admiration, notwithstanding it is exhibited by a harmful bird? — L. J. Stroop, *Waxahachie, Ellis county, Texas, August* 24, 1870.

American Panther. — The Catamount, Cougar, or Indian Devil, as the American Panther (*Felis concolor*) is called, is said to be still common in the wild regions of the Adirondacks. Mr. H. H. Bromley of the Chasm House informs me that dead ones have often been found in the woods, having been killed by the spines of hedge-hogs which they had attacked. — F. W. P.

Notes on Some of the Coast Fishes of Florida. — During a residence of three months in East Florida last winter, I sailed up and down the Halifax, Indian, and Hillsboro' rivers, and enjoyed fine sport with the fishes of that region, many of which I found to be of the first excellence on the table.

Sheepshead (*Sargus ovis* Mitchell). At New Smyrna, near the Musquito Inlet, we caught them in great numbers of two to seven pounds weight. In two hours, at half flood, two of us would often get from twenty to thirty fish, averaging four pounds each; bait, clams or conchs.

Bass, or Red-fish (*Corvina ocellata* Cuv.). This fine fish I found plenty all along the coast about the inlets. They are from two pounds to fifty, as I am informed by fishermen; but the largest taken by me weighed twenty-five pounds, and was caught in the narrows of the Indian River, by trolling with a mullet bait and hand line. At about half flood we caught them by casting a hand line, with mullet bait, far off into the surf, or by fishing with a rod and line where the channel ran near the beach. This fish much resembles the striped bass (*Labrax lineatus*), in habits, and is quite as game a fish on the hook. I had many hooks and many yards of strong bass line taken away by them, as they fight fiercely to the last. This is a very good fish on the table; rich, firm and delicate. Its color is very brilliant when recently taken; steel blue on the back, of a golden copper hue on the sides, and white beneath; scales large; tail square; first and second dorsal with sharp spines; teeth numerous and small in the jaws; large and enamelled on the vomer.

Cavalli or Crevallé (*Lichia Carolina* DeKay). Family of Scombridæ. Shape between that of dolphin and mackerel, though deeper than either; color blue, gold and silver, and changeable like the dolphin; from two pounds to fifteen; goes in schools and takes a bait of mullet eagerly; will also take a red rag or spoon, trailed behind a boat; a very active and strong fish; good eating, though rather dry. Holbrook in his "Fishes of South Carolina," seems to confound this species with the Pampano (*Bothrolæmus Pampanus*), a very highly prized table fish of the southern waters. The latter, I am informed by old fishermen on the Florida coast, never takes a hook, and can only be taken in nets, and at night. It much resembles the Crevallé in appearance.

Sea-trout (*Otolithus Carolinensis* Cuv.). This belongs to the same family as the Weak fish of the New York coast. In shape and color it resembles the lake trout of the Adirondack region, but wants the adipose fin which distinguishes the salmon, and of course is not a true trout. It is an active game fish, takes a mullet bait or clam; weight from two pounds to fifteen; color steel blue on the back and sides, with black spots; under parts, white and silvery; inside of mouth, yellow; head small, teeth strong, tail waved in form, with a double dorsal fin, with spines.

Black Snapper (*Mesoprion pargus* Cuv.). Belongs to the family of Percidæ; is in form like the tautog; a bottom fish, with large mouth and strong teeth; bites eagerly at clam or mullet, and pulls hard; silvery in

color when first taken, then turns red, and lastly black; is one of the best of the southern table fishes; weight, from four to sixteen pounds.

Crab-eater, Sergeant fish (*Elacate Atlantica* Cuv.). Family of Scombridæ, or mackerels; found along the shores of the inlets, where it lurks for prey among the mangrove roots; very voracious; takes clams or mullet bait; color, silvery, with a black stripe along the sides; hence its local name of Sergeant fish; the under jaw longer than the upper; weight up to twenty pounds; a good table fish, though inferior to the former.

Whiting or King-fish (*Umbrina alburnus* DeKay). Shaped like a perch, double dorsal with strong spines; color, gray and black above, yellowish white beneath; mouth and teeth small; bottom fish of deep water; takes clam bait; very good table fish; weight, from one to two pounds.

Croker (*Micropogon undulatus* Cuv.). A southern fish of the perch family; in form, deep like the sheepshead; color, silvery; takes clam bait eagerly; weight, from one to two pounds; a good table fish.

Hog-fish, Sailor's Choice (*Hæmulon fulvomaculatum* Mitchell). Shaped like the last; a good pan fish; weight, from half a pound to a pound; takes clam bait on the bottom.

Cat-fish, of the salt-water (*Galeichthys marinus* DeKay). Handsomer in form and color than the fresh-water cat; has a forked tail and very high dorsal fin; takes fish or clam bait on the bottom; weight, 10 to 15 pounds.

Black trout (*Grystes salmoides* Lacepède). This is a fresh-water fish of the perch family, much resembling in appearance and habits the black bass of the western waters, except that it has a larger head and mouth, and grows to a larger size, say to twelve or fifteen pounds. It takes live bait, spoon or bob, which is a bunch of colored feathers with three hooks concealed among them.

Besides the above fishes, these waters contain blue fish, Spanish mackerel, beluga, mullet, Jew fish, drum, shad, lady fish, porpoise, sharks, saw fish, sting ray, the hawk's bill turtle, the soft-shelled turtle, the green turtle, clams, oysters and crabs, of various kinds. — S. C. Clarke.

GEOLOGY.

Discovery of Lower Carboniferous fossils on the Rio Tapajos. — I am just returning from a very interesting and profitable trip up the Rio Tapajos, where I have had the good luck to discover an extensive set of limestones, sandstones, and shales, of lower carboniferous age, from which I have made a very large collection of beautiful fossils. As near as I can ascertain at present, I have at least one hundred and fifty species of Brachiopods, Lamellibranchs, Polyzoons, Gasteropods, Trilobites, fishes, and a few plants, the majority of the species being determinable. Of the Brachiopods I have some magnificently preserved specimens, showing interiors. I am going back to Pará to give up my little steamer and divide up my party. I then return to the Tapajos with a very small party, including a photographer, to examine more carefully,

not only these rocks, but to study the Amazon sandstones and clays. I have seen nothing to cause me to change my opinion about the age of the last named formation. I have not succeeded in finding any fossils in them. I have found beautiful fossil leaves of apparently recent plants, in a recent ironstone. In the hill of Creré, Monte Alegre, and near Santarem, beds of basalt occur. — C. F. HARTT, *on board Government Steamer "Jurupensem," near Monte Alegre, Rio Amazonas, Oct. 5th*, 1870.

NEW FOSSIL FISHES. — Prof. COPE has recently studied the genus *Saurocephalus* and allies, from the Cretaceous, and states as a result, that these fishes are not in the least related to the *Sphyrænidæ*, where they have been placed heretofore. The structure of the mouth is like that of the *Characinidæ*, while the neural arches are distinct and the tail vertebrated as in *Amia*. The pectoral spines have been described by Leidy, as those of a Siluroid, under the name of *Xiphactinus;* and the beautifully segmented rays referred to Ptychodus, by Agassiz, he regards as the anal or caudal rays of *Saurocephalus*. The affinities might be more correctly expressed as combining characters of Salmo and Amia. Professor Cope describes a new genus, *Ichthyodectes*, type species *I. ctenodon;* the former differs from the known genera, *Saurocephalus* and *Saurodon*, in not having the series of nutritious foramina on the inner side of the alveolar ridges. He refers these fishes to a new family, under the name of *Saurodontidæ*.

PLASTICITY OF ROCKS. — The old cobble-stone pavement in Waverly Place, between Broadway and Mercer street, being now in process of removal, my attention has been drawn to the forms of the stones, especially the harder ones, quartzites, etc. The coarser granulated paving stones have generally crumbled, but the compact stones have been modified — convex surfaces in one case fitting into concave in another; none of them retaining a normal form. Now, although the crown of these stones has been worn by the attrition of constant and heavy travel, no such wear can have taken place on their perpendicular surfaces, and I am therefore convinced that they have been moulded into one another by pressure only. On conversing with the workmen, they all concurred as to the fact, and the foreman stated that his attention had been called to it before. Very probably I am myself only repeating what is already well known to others. — GEORGE GIBBS, *New York*.

SALT PLAINS IN NEW MEXICO. — Brevet Major General August V. Kautz, U. S. Army, writing from Fort Stanton, New Mexico, informs me that there is a valley of some two hundred miles long and twenty wide, lying between the Sierra Blanca and the San Andreas and Occura mountains, in that Territory, in which there is no stream, and only a few alkaline springs and salt lakes, or ponds. Where the road from Fort Stanton to El Paso crosses it, about sixty miles south of that post, is a plain of white sand, apparently granulated gypsum, which has drifted into mounds, forty and fifty feet in height. Water of a strongly alkaline character is obtained by digging a few feet, and around the edges of this district, salt marshes exist, where in the dry seasons, great quantities of almost pure salt may be collected. The sand is so white and the plain so extensive as

to give the effect of snow scenery. As I do not remember to have seen a description of the place in print, I send you this note with a specimen of the sand forwarded by General Kautz. — George Gibbs, *New York.*

MICROSCOPY.

A New Form of Binocular for use with High Powers of the Microscope.* — Of the several forms of binocular arrangement for the microscope which have hitherto been constructed, only such as are adapted for use with low powers exclusively, have as yet come into general use. Of these, the Wenham prism is the popular favorite, and hardly any other form is employed at all by British or American constructors. Mr. Wenham's binocular, when employed with powers below about one-half inch, leaves nothing to be desired; but with higher powers than this, the field is so imperfectly and so unequally illuminated that it ceases to be available.

The Wenham binocular, like the original binocular of Dr. Riddell, and like the different forms constructed by Mr. Nachet, divides the light, after it has passed the objective, by a vertical section passing through the middle of the entire bundle of pencils, into two equal portions, one of which is directed to each eye. But although the entire body of the light is thus equally divided, the same is not true of the several pencils which make it up. Only those pencils in fact can undergo equal division whose radiant points in the object lie exactly in the plane of the section. All others will be divided unequally, and the inequality will be greater in proportion as the radiants are more distant from that plane. If the division could be effected at the centre of the front lens of the objective, the inequality just spoken of would disappear; but such a division is of course impracticable. With objectives of low power, the base of each conical pencil of rays (which is the area of the front lens of the system) is so large, that the inequality of illumination consequent upon the unequal division of the pencils themselves is not sufficiently great to be objectionable; but with high power objectives, the pencils are very slender; and at the distance behind the combination at which it is necessary to place the binocular construction, many are very disproportionately divided, and many escape division altogether.

By the introduction of an erector into the body of the microscope, the pencils, which cross each other once in entering the front lens of the combination, may be made to cross a second time; and it is obvious that if the dividing apparatus of the binocular be introduced at the point of this second crossing, all the pencils will be divided with the same equality as they would be if the division could be effected at the centre of the front lens itself. Availing himself of this principle, Mr. Tolles, some years since, constructed a binocular eye-piece which solves completely the optical problem under consideration for all powers; but this instru-

* Read by F. A. P. Barnard LL. D., President of Columbia College, N. Y., before the Microscopical Section of the American Association for the Advancement of Science, Troy meeting.

ment is costly, and apart from this objection, it has for some reason or other failed to become a favorite with those who have used it.

It is now two or three years since Mr. Wenham suggested the practicability of constructing a binocular for high powers, by means of a contrivance which should reflect one-half the light of each pencil and transmit the other half. This plan was to take a glass prism with parallel surfaces, and to cut this by an oblique section at an angle suitable to reflect one-half the light which should be incident upon it after entering the prism perpendicularly to one of the original faces. The two portions of the divided prism being replaced in position to reconstruct the original prism, the surfaces of section being very nearly but not quite in contact, the whole is placed behind the objective, when the transmitted portion of the light will give one image, while the reflected portion, after a second reflection within the prism, will furnish the other. In this arrangement there is a possibility of some confusion in the image seen by reflection, in consequence of the duplication of the reflecting surface. On this account, or for some other reason not stated, Mr. Wenham did not follow up his invention.

In the January number of "Silliman's Journal" for 1868, Professor Hamilton L. Smith, now of Hobart College, described a binocular arrangement invented by himself, in which it was proposed to effect the division of the light by means of a long thin glass reflector placed very obliquely in the body of the microscope. As both surfaces of such a mirror will reflect light with intensity, it is necessary that these surfaces should not be parallel. It was Professor Smith's first idea to make the reflecting plate sufficiently wedge-shaped to throw the second image out of the field; but experiment showed him that, by making the inclination of the surfaces very slight, the images might be made perfectly to coalesce. This construction involved the disadvantage that the length of the body of the microscope could not be varied, but it was attended with an important saving of light. Hitherto Professor Smith's binocular has not been constructed by regular opticians, and its merits are not fully known. The constructions by Professor Smith himself perform very well, but have a rather limited field.

Messrs. Powell and Lealand, of London, have patented a binocular which resembles Professor Smith's in that it divides the light by reflection at the first surface of a glass mirror; but the surfaces of this mirror are parallel, and the image from the second surface is got rid of by giving to the glass considerable thickness. The reflected rays are reflected a second time by means of a right angled prism. As this arrangement is actually constructed, the image seen by reflection is greatly inferior in brilliancy to that formed by the transmitted rays. In fact, when very high powers are employed, the image by reflection is practically unavailable for any useful purpose. This evil might be remedied by increasing the angle of incidence at which the rays from the objective fall upon the first reflecting surface; but this expedient would be attended

by a large increase in the amount of light lost at the second reflecting surface, and by a corresponding diminution of the brightness of the image seen by transmission.

Binoculars constructed on the principles of those last described may be called *cata-dioptric*, in contradistinction from those which split the body of the light geometrically, and which are properly denominated *stereotomic*. They have not the advantage which belongs to stereotomic binoculars, of presenting the object viewed in all its three dimensions. But they permit what most observers regard as very desirable, or find at least very comfortable, the use of both eyes at the same time. It is true that there are many whom practice has so accustomed to the use of a single eye, that they profess to suffer no inconvenience from this mode of observation, and regard binoculars with indifference except so far as they are recommended by their stereoscopic effect. But however slight may be the momentary inconvenience attendant on observation with a single eye, it is believed that no microscopist can continue to observe in this manner for a series of years, without finding that his eyes have lost the equal power which they once possessed of accommodating themselves to distances. It seems impossible to prevent this result from supervening sooner or later, unless by maintaining a strict impartiality in the employment of the eyes alternately at the microscope; and this is what few remember, or if they remember, are disposed to do. If by the use of a binocular this evil can be prevented, this fact alone is sufficient to make a good form of this instrument adapted to the higher powers desirable. Such a form is believed to have been found in the construction now to be described.

If a rectangular prism of calc spar be cut with four of its faces parallel and the other two perpendicular to the direction of the optic axis, a ray of light incident perpendicularly upon any one of the lateral faces will be divided by double refraction into two rays, but both of these two rays will pursue the common direction of the incident ray continued. There is a large difference between the two indexes of refraction. The index of the ordinary ray is 1.6543, and that of the extraordinary, 1.4833. If now the prism be divided by a plane section oblique to the axis, the two rays co-incident in direction, as above supposed, will be unequally reflected by this plane. And the ordinary ray will suffer total reflection at an angle at which the extraordinary ray is almost totally transmitted. The angle of total reflection for this ordinary ray is 37° 11′, while that at which total transmission occurs for the extraordinary ray is 34° 2′. From 34° to 37°, the amount of light reflected from the extraordinary ray is inconsiderable; amounting at the latter angle not quite to eight one-thousandths of the entire ray, and to four one-thousandths of the total intensity of the ray originally incident upon the prism. If, therefore, the supposed calc spar prism were cut by a plane, making an angle of 37° 11′ with one of its lateral faces, a ray incident perpendicularly upon this lateral face and meeting the plane of section, would be half reflected and half transmitted,

or so nearly so that the inequality would be imperceptible. Moreover, the very minute portion of the extraordinary ray which would undergo reflection, would deviate more than two degrees from the direction of the reflected ordinary ray; and so, supposing this prism to form part of a binocular arrangement for the microscope, would be thrown out of the field.

But the pencils of rays which go to form the image in the body of the microscope have a certain angular spread. If, therefore, the axis of the central pencil be perpendicular to a given plane, those of the lateral pencils will be inclined to the same plane. Accordingly if this central axis were to be incident on the supposed plane of section at 37°, the incidences of the lateral pencils would vary between 34° and 40°, or possibly between limits somewhat larger. Also as the lateral rays of each pencil are inclined more or less to the axes of the same pencils, the limits of maximum and minimum incidence would be more largely extended by this circumstance. For low powers we should have to allow for a range of incidences embracing perhaps eight or nine degrees of difference. For very high powers this range would hardly exceed six.

If the incidence of the central axis is fixed at 37° 11′, the angle of total reflection for the ordinary ray, then the lateral pencils of this ray, whose incidences are less than 37° 11′, will be to a certain, but not very considerable, degree, transmitted. This does not affect the definition of the image seen by transmission, but it gives it a slight superiority to the other in respect to brightness. If, however, the incidence of the central axis is made as great as 39°, the two images become sensibly equal in brightness. In this case some of the lateral pencils of the extraordinary ray will attain an incidence of 42°, at which point the amount of reflection is quite sensible, but this does not materially affect the middle of the field, nor is it sufficient to impair, perceptibly, the brilliancy of the image seen by transmitted light.

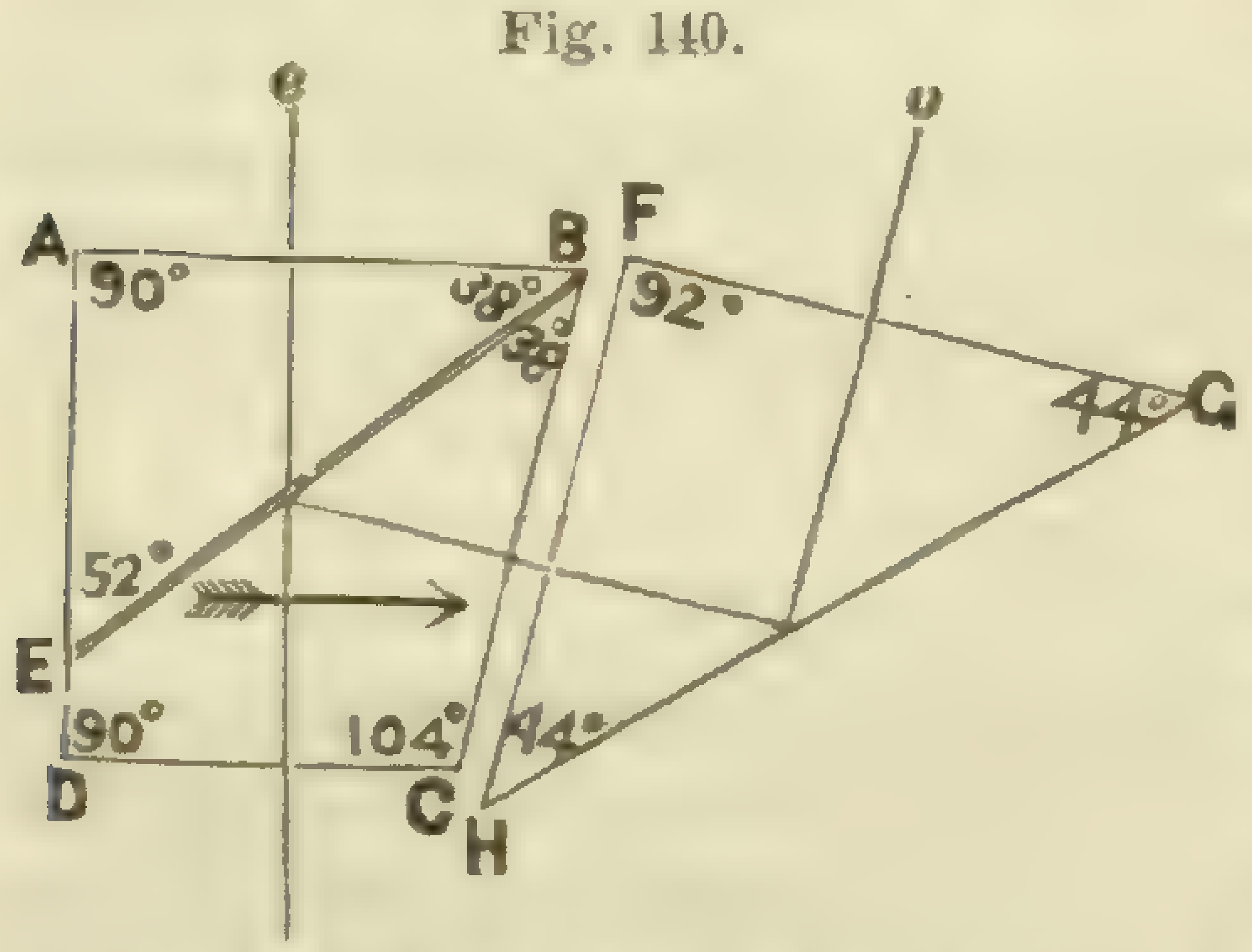
It is now about three years since the plan of a binocular founded on the principles above explained, was devised by the writer of this paper; but this plan was not immediately realized in consequence of a difficulty encountered in obtaining calcite prisms suitably prepared. Opticians were applied to in London, and in this country, but no one was found willing to attempt the preparation. In the spring of 1869, Professor Rood, of Columbia College, kindly lent his aid to the accomplishment of this undertaking, so far as to verify experimentally the anticipations of theory; but time would not permit him to give to the prisms the finish required for a perfect instrument. The work was finally done during the following summer by Hoffman of Paris, with results entirely satisfactory.

In the original construction the calcite prism was made rectangular. The ordinary ray, after reflection from the surface of section, emerged from the terminal plane at an incidence of twelve degrees. It was reflected a second time by means of a triangular prism of flint glass having nearly the same index of refraction, of which the first surface was placed

parallel to the terminal plane of the calcite. It was thought that the very nearly equal and opposite refractions thus suffered by the ray would suffice to prevent sensible aberration; and this is nearly true. But the unequal dispersive power of the two substances makes itself slightly manifest when the objectives used are low; though this defect disappears in the case for which the instrument is intended — that is with high powers. Nevertheless, it has been thought best in new constructions now preparing, to give such an obliquity to the terminal plane of the calcite that the reflected ray may be incident upon it perpendicularly, and to modify correspondingly the flint glass prism. On the whole it appears to be best also to give the plane of section an inclination of about 38° instead of 39°. Indeed it would appear that, for low powers, the lower angle is preferable, and for high powers the higher; doubtless because, on account of the larger range of differences of incidence in the former case, there is a larger reflection of the extraordinary ray, which is greatly reduced by a very small change in the angle of incidence. For this reason it is convenient to have the system of prisms so mounted that it can receive a slight rotation about an axis perpendicular to the plane of reflection, and to adjust it to the position most satisfactory with the power employed.

The annexed figure (140) will serve to give an idea of the form of construction now employed. ABCD is a section, parallel to one of the lateral faces, of a calcite prism, originally rectangular, of which the optic axis is parallel to the section, and to the sides AB and DC. This prism is divided by a plane perpendicular to ABCD, making an angle of 38° with AB and 52° with AD. Also, the face, BC, inclined 14° to the original face of the rectangular prism, is made to replace that face. The prism, when completed, should have its lower face square, and the side of the square which is equal to DC, should be six-tenths of an inch. The remaining dimensions will be determined by this, and by ED, which should be three-twentieths of an inch. The surfaces of section, BE, may be brought very near to each other. In the construction actually employed they have been separated only by a single thickness of tinfoil, introduced at each of the angles.

Fig. 140.

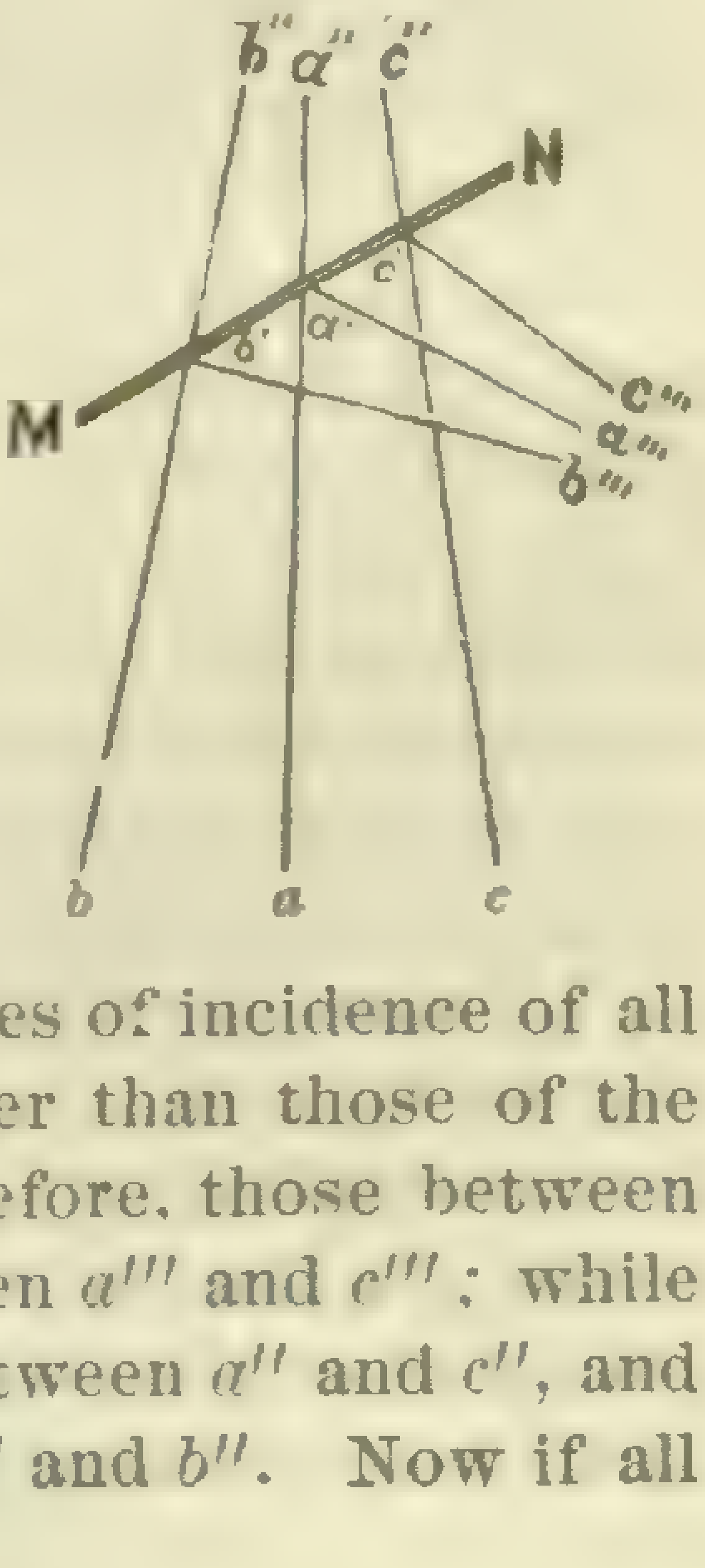


The prism, FGH, is of flint glass with a refracting index as high as 1.56 or higher. It is isosceles, having an obtuse angle of 92° at F, the acute angles being equal and each 44°. The side, FH, being parallel to BC, a ray incident perpendicularly upon DC, and doubly refracted by the prism, is resolved into the two rays, *e* and *o*, of which the first is transmitted, and the second, reflected by BE, passes perpendicularly through the two surfaces, BC and FH, is a second time reflected by GH, and finally emerges

at right angles from the face FG. The inclination of o to e is twelve degrees. It would be preferable to make it somewhat less, as this inclination allows only a length of body to the microscope of about seven inches. By employing in the prism, FGH, glass of higher refracting power, it may be made less, and by using calcite for this prism, or in other words, by making BCDE and FGH all of a single piece, the same object may be attained to any desired degree. The objections to this latter plan are twofold. The first relates to the difficulty of construction. It is said that the Wenham trapezoidal prism of glass is troublesome to make. The difficulty would be much increased in the use of such a material as calcite, especially when it is necessary to preserve an exactly prescribed relation between the faces of the prism and the optic axis. The second objection is found in the consideration that, in order to adapt the tubes of the binocular to the eyes of different observers, it is necessary to give to one of the tubes an angular movement, moving the prism, FGH, at the same time, by half the same angular amount, as is done by Mr. Nachet in one of his forms of binocular; or to move this tube and prism laterally, as Mr. Nachet has also done in another of his forms. This necessity arises from the fact that, if the tubes are sufficiently inclined to each other to permit an accommodation to different eyes by running them in and out, as is done by Mr. Wenham, they must be made shorter than is desirable. The reflected pencils might be made to cross the transmitted before reaching the eye, as is done both in Wenham's and in Powell and Lealand's contrivances; and this would remedy the inconvenience last mentioned; but it would necessitate the use of a prism, in place of FGH, of difficult construction, and of greater size than is desirable.

But there is another objection to the crossing of the pencils which is more serious. This binocular, as actually constructed, produces, when used with moderate powers, a sensibly stereoscopic effect. Nor is it difficult to understand why it should do so. In any stereotomic binocular, Wenham's for instance, it will be observed that the half of each pencil which falls upon the front lens of the objective, is carried to the opposite eye; and this ought to be so, because the image actually seen is reversed in position. Now, by considering the figure annexed (141), it will be seen that if $aa'a''$ be the axial ray of a converging pencil of which $bb'b''$ and $cc'c''$ are the lateral limiting rays, and if a transparent reflector, MN, be interposed obliquely in the path of this pencil, the angles of incidence of all the rays intermediate between a' and b' will be larger than those of the rays between a' and c'. Of the reflected rays, therefore, those between a''' and b''' will be more abundant than those between a''' and c'''; while of those which are transmitted the excess will lie between a'' and c'', and there will be a corresponding deficiency between a'' and b''. Now if all

Fig. 141.



the light except these excesses should be extinguished, it will appear at once that the illumination still outstanding would be such as is required to produce stereoscopic vision; that is, each half of the pencil would go to the opposite eye. In our calcite prism, we have seen that in, for instance, the central pencil, there is total reflection for the ordinary ray between a' and b', but that there is some transmission toward c'. The extraordinary ray, on the other hand, is almost totally transmitted between a' and c', and loses something by reflection toward b'. These effects are more marked in some of the oblique pencils, and the consequence is, that, with low powers, the stereoscopic appearance is very perceptible. To cross the reflected rays upon the transmitted behind the prisms would therefore be productive of a pseudoscopic effect which would be objectionable. But with high powers, on account of the small difference of incidence existing in that case between bb' and cc', the image appears plain.

As a test of the performance of this binocular, it may be mentioned that, by means of it, the most difficult natural objects have been resolved by observation with both eyes, or with either eye singly. With a Wales' objective marked one-thirtieth, but more exactly rated one-twenty-fifth, and with the B oculars, the Providence Grammatophora is thus resolved with great facility.

When the power used is below one-fourth, there is a little haziness produced in the image seen by reflection, in consequence of the mingling of the, to some extent, reflected extraordinary ray, from the clear field surrounding the object. This effect is immediately removed, by placing over the slide a card, out of which has been cut a slip having the width of the field. Such a card, or a similar thin plate of metal, may be easily secured to the stand, so that the stage and slide may move beneath it while it remains fixed. This haze is moreover suppressed still more easily by slightly tilting the system of prisms, so as to diminish by a degree or two the angle of incidence upon the reflecting plane of section. This really gives to the image seen by transmission the advantage in respect to illumination; but as, with low powers, both images are strongly illuminated, the difference is scarcely noticeable. It is well, therefore, in mounting the prisms, to provide some system of adjustment by which the position may be varied to correspond to the power employed.

Some experiments have been made with calcite prisms cut in such a manner that the extraordinary ray proceeding from common light perpendicularly incident upon the first surface, should fall at a smaller incidence than the ordinary upon the surface of the reflecting section. Thus, if, in figure 140, the optic axis has the direction BE the extraordinary ray will deviate toward the left, from the ordinary, after perpendicular incidence on DC, by nearly five degrees. This is favorable to the transmission of the extraordinary ray through BE; but as the index of extraordinary refraction is considerably greater in this direction, the amount of loss by reflection is about the same as before. The construction employed at first gives results which are very satisfactory; but it is designed to pur-

sue experiment further, and with the able assistance of Mr. Joseph Zentmayer, whose zeal for the improvement of the microscope has induced him to undertake the rather troublesome task of preparing the prisms, it will soon be ascertained whether or not any material advantage can be gained, by adopting a different plan of cutting them.

NOTES.

Our readers are doubtless aware that Congress at the last session made an appropriation of $50.000 for Arctic exploration, with the promise that the scientific operations of the expedition were to be prescribed by the National Academy of Sciences. Captain Hall was appointed by the President of the United States to command the expedition in question, and a commission of the National Academy, recommended by Professor Henry are to act in concert with him, and prepare a manual of scientific inquiry for the use of the expedition, which will, undoubtedly, interest a large circle of readers when published.

Mr. A. Hyatt has been appointed Professor of Palæontology at the Massachusetts Institute of Technology. Mr. E. S. Morse has been chosen Professor of Comparative Anatomy and Zoology at Bowdoin College, and has been appointed Lecturer in the same branch at the Maine Agricultural College. Dr. A. S. Packard, jr., is to lecture on Economic Entomology at the same institution. Mr. B. K. Emerson has recently been elected Professor of Geology at Amherst College, the chair filled for so many years by Dr. Edward Hitchcock, Senior.

Chicago offers a new publication for general patronage, under the title of the "American Journal of Microscopy." The first number, for November, is of quarto size and contains sixteen pages. The Journal is to be published monthly, by George Mead & Co., 182 South Clark Street, Chicago. Mr. Mead is the editor. Subscriptions at $1.00 a year are solicited, and contributions on microscopical and kindred subjects are requested from all parts of the world.

Dr. Hagen has recently returned from Europe, having purchased, through funds furnished by a lady in Boston, for the Cambridge Museum, a Parisian collection of weevils of great extent and value. We are glad to know that he has brought over his own unrivalled collection of Neuroptera. Its presence in this country is most fortunate for this department of entomology.

The addition to the building for the Museum of Comparative Zoology at Cambridge, at an expense of upwards of $60.000, is rapidly going up. Professor Agassiz has returned to Cambridge with restored health, and with new plans for the enlargement of his Museum.

The Lyceum of Natural History of New York has lately started forwards with renewed vigor, and now issues its "Proceedings," as well as "Annals." Three signatures of the "Proceedings" (from pages 1 to 44), have been received, and contain abstracts of several interesting papers read at the meetings in April and May last.

Gradually the unpublished results of the labors of Dr. T. W. Harris are being given to the public. Mr. P. R. Uhler, of Baltimore, has ready for publication by the Boston Society of Natural History, descriptions of the Hemiptera of the Harris Entomological collection.

Congress is about to print an entomological report by Townend Glover, the entomologist of the Agricultural Department. It will form an exceedingly useful work, and will deserve the widest circulation.

The well-known Paris dealer in insects, M. Deyrolle, took flight to London with his immense stock of insects, before Paris was actually invested.

Mr. J. A. McNiel, who has made two expeditions to Central America, is now in Philadelphia preparing for a third Archæological Excursion to Nicaragua.

Prof. O. C. Marsh of Yale College, has just returned, with his party, from the Rocky Mountains. The Expedition started in June last.

All our French exchanges, months ago, were suspended.

ANSWERS TO CORRESPONDENTS.

A. D. H., Tuscaloosa. Ala.—The larva taken from oak wood is the Oak-tree Borer (*Xyleutes robiniæ*), one of the silk worm family (*Bombycidæ*). It often does damage to the red oak, though the moth, a large ash gray species, is comparatively rare.

C. E., Cincinnati.—A light dredge, such as is described on p. 269 and figured on p. 274, Vol. iii, of the Naturalist, will answer your purpose. A stout clothes line will do for a rope; with a five-pound window weight or fishing lead to sink the dredge. In sounding, use a stout fishing line, with a hollowed two-pound lead weight tied to the end, the hollow to be filled with soap. Fathoms can be measured off with strips of red tape tied in the cord. Look out for minute worms and small crustacea, such as the water fleas, and especially the larger shelled forms, such as Lymnadia, Estherea, etc.

E. S. M., Mitchell, Ind. Your photograph is that of *Dynastes Tityus*, male. A pair would be very desirable for the Museum of the Academy.

H. G., Detroit.—We requested an answer to your question from a physiologist of the highest standing, and have received the following in reply: "The subject is a very important one, as experts are often called upon to decide whether a given blood-stain is or is not human. Many enthusiastic microscopists have full confidence that nothing is easier than to decide the matter by looking through their instruments, until they find themselves cross-questioned by a sharp lawyer.

Human blood is easily distinguished from that of many mammals, birds, reptiles and fishes, by the size and form of the globules; and tests, both chemical and microscopical, have been proposed for distinguishing human blood from that of some of the domesticated animals. In medico-legal cases, such, if good, would be of the utmost importance, but it is generally conceded that none exist which can be admitted as absolute. If an observer had given him blood from man and the dog, without knowing any circumstance which would lead to an opinion as to their origin, there is no valid sign which would justify him in going into court and saying which was and which was not human. The test of odor given off when sulphuric acid is added to the blood, however successful it may have once been in the hands of some experts, has not, after many years, come into use, and that of the size and appearance of the globules also fails, as the globules of some of the domesticated animals offer the same characteristics as those of man."

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THE ANT LION.

BY J. H. EMERTON.

Fig. 159.

Ant Lion, adult.

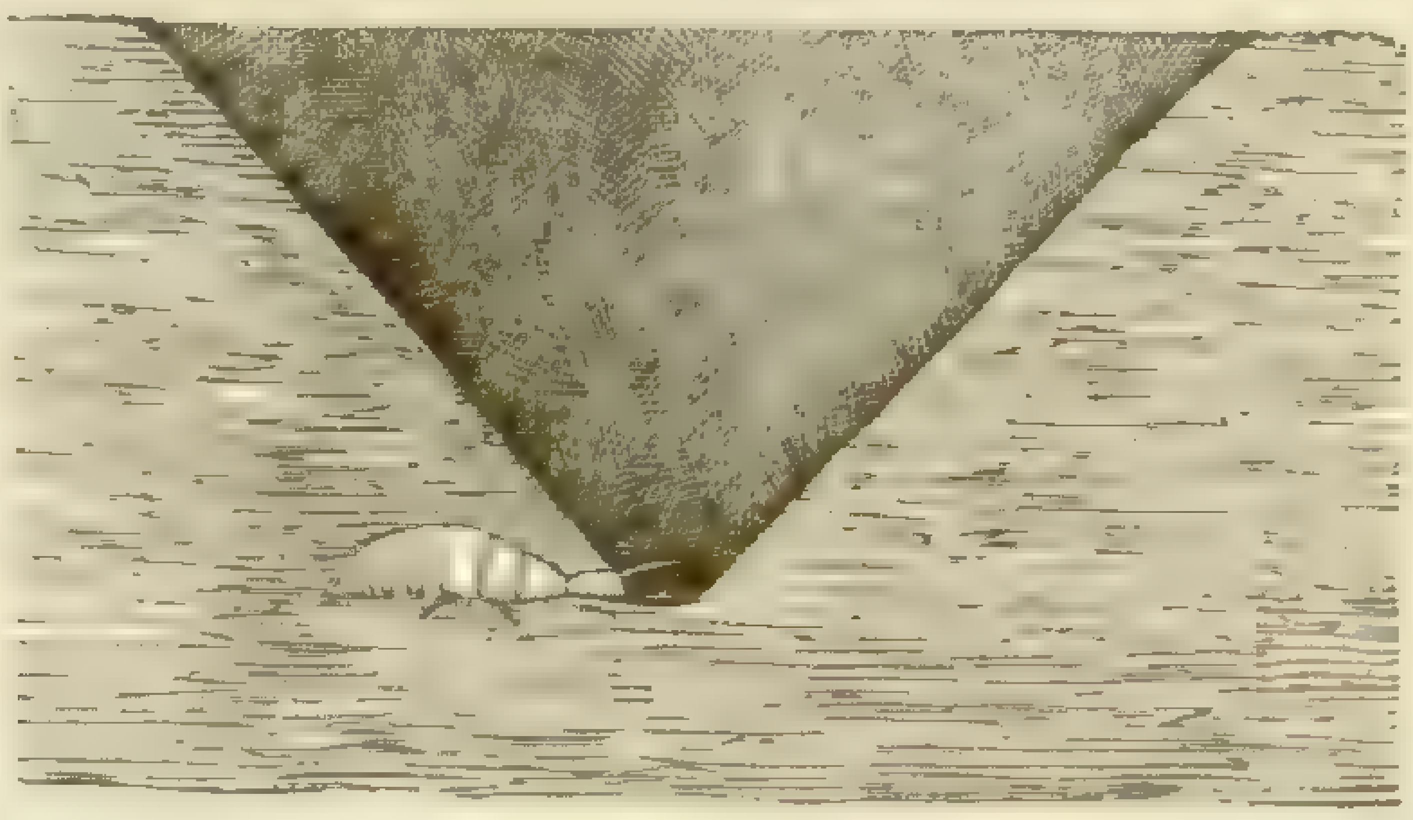
On the twenty-ninth of August, while hunting spiders among the rocks on the hill north of Bartholomew's pond in South Danvers, Mass., I unexpectedly found the pit of an ant-lion (*Myrmeleo immaculatus* De Geer), in a clear space under the shade of a large boulder. The pit (Fig. 160) was about two inches in diameter and one deep. The insect himself was hid at the bottom, but when I dropped bits of earth into the hole he showed his position by throwing up sand. I then dug him out and took him home with me, where I put him into a bowl of dry, coarse sand, such as is used by masons for mortar. He remained buried for several days, but finally came to the surface, dug his pitfall, and gave me

Entered according to Act of Congress, in the year 1870, by the Peabody Academy of Science, in the Clerk's Office of the District Court of the District of Massachusetts.

an opportunity of observing his habits. Fig. 161 represents the ant-lion at this time, showing the under side with the feet in a natural position. At first he was so timid that as soon as any one approached he stopped where he was and remained motionless until left alone. If his pitfall was destroyed he dug a new one; but during all the time I kept him I never saw the whole process of digging it.

Fig. 161.

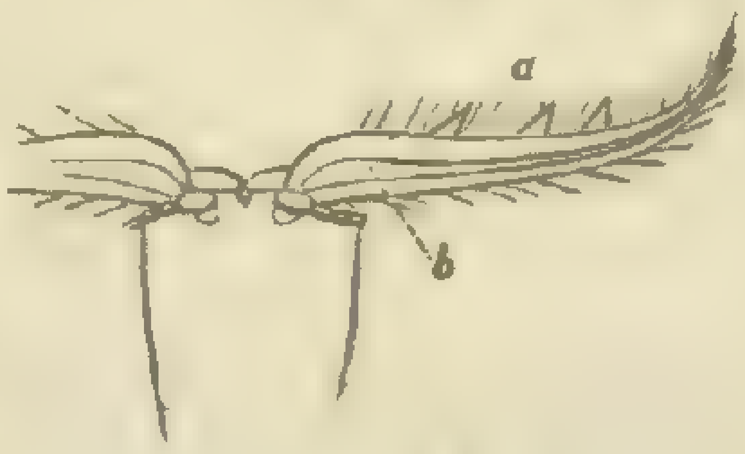
Fig. 160.



Ant-lion.

When taken out of the sand and laid on the surface he would keep quite still for a few moments, then retreat backward, by jerks, under the sand. He never moved forward but always backward by the contractions of his abdomen as much as by his feet, making a furrow through the sand. He seldom travelled an inch in one direction, and often made a complete circle in that distance. I think he commenced his pitfall by making a circle of this kind, and afterward throwing out the sand from the centre. In digging he used his flat head and jaws, which were pushed under several grains of sand and then jerked upward, throwing their load sometimes as far as six inches, and always far enough to avoid leaving a ridge around the pitfall. When the pit was finished he was entirely concealed beneath it, as in Fig. 160, except his jaws, which were spread apart horizontally at the bottom. The surface of the pit being as steep as the sand could be piled up was very easily disturbed, and when an insect ventured over the edge the ant-lion was apprised of it at once by the falling sand. He immediately began to throw up sand from the bottom, deepening the pit and so causing the sand to slip down from the sides and the insect

Fig. 162.



with it. The ant-lion seized it with his long jaws and held it up above his head until he had sucked all he wanted from it, when he threw the remainder out of the hole and repaired the trap. Fig. 162 (from Westwood), shows the structure of the jaws, and how the ant-lion may drink the juices from an insect without bringing it to his mouth. On the under side of each jaw (*a*), is a groove (*b*), extending from one end to the other, and partly filled by the slender maxilla which lies in it, forming a tube, one end of which passes into the insect which is bitten, while the other opens near the mouth of the ant-lion. After eating he became more timid, and sometimes would not take a second insect. If, however, several were put into the pit at once, he would bite one after the other until all were killed, before deciding on which to begin. I fed him two or three times a week, usually with house-flies, cutting their wings off and letting him take them in his own way. In October, having occasion to travel some distance, I put him in an ounce bottle half filled with sand, corked him up, and carried him with me in my bag. In about a week I gave him a large house-fly, which he did not catch, not having room enough in the bottle to make a pitfall. I gave him no more food till the next March. Meanwhile he remained for several months on a shelf in my room. Occasionally I tipped him out and always found him lively enough to right himself if turned on his back, and to retreat under the nearest sand. In January he was packed up in my trunk for more than a week, and when I opened it, after it had remained several days in a warm room, I found him as lively as when first caught. He afterwards became quite torpid again in a cold closet, where he remained through the rest of the winter. About the first of March, when flies began to be plenty, I commenced to feed him again. He found it rather awkward to catch insects in the bottle as there was not room enough to make a pitfall, and his inability to move forward made it hard for him to seize an insect unless he met it directly between his jaws.

He soon, however, made pitfalls half an inch in diameter, which answered the purpose. Sometimes he lay on the surface of the sand with a few grains scattered over his back to conceal him from notice, and his jaws extended on the surface. If a fly was put into the bottle it would circle around close to the glass and usually run over the ant-lion's back. He would jerk up his head and attempt to seize it, which he seldom succeeded in doing the first time. If he caught a leg or wing he was unable to move nearer and shorten his hold, and the fly escaped. He would often throw up the sand and try to undermine the fly. He would sometimes work an hour in these ways before the fly would get into a favorable position. I fed him every day or two until May 15th, when he spun a spherical cocoon (Fig. 161*a*) around him, and remained enclosed until June 25th, a very hot day, when he came partly out, and leaving his pupa skin half in the cocoon appeared as a perfect fly (Fig. 159), but did not spread his wings completely.

THE RESOURCES AND CLIMATE OF CALIFORNIA.

BY REV. A. P. PEABODY, D.D.

The thought uppermost in my mind, during a recent visit to California, was of gratitude to the bravely patriotic men, who, in the late rebellion, at the risk of their own lives saved this great state for the Union.

One who has not been in California can hardly appreciate the magnitude of the threatened loss. The state might easily have maintained her independence, not only of her sister republics, but of all the world beside. It is potentially a self-sustaining empire. Exceeding in the aggregate of its territory the British Islands, it extends through all the degrees of latitude which are identified with a genial climate,

without stretching far enough northward to know the severity of winter, or far enough southward to feel the enervating influence of a tropical sun.

It could supply all its own wants. Its pastoral regions could easily furnish wool, hides and food for twenty times its present population. Its rivers and bays swarm with the choicest of fish, salmon being so abundant that it can hardly be accounted a luxury. The vine-bearing capacity of the one county of Sonoma exceeds that of all the wine-growing regions of Europe. Wheat has been harvested at the rate of ninety bushels to the acre, and fifty or sixty bushels are but an ordinary crop, twenty being regarded as a good yield in the Genesee district of New York. The fruits are unsurpassed in quality and in profusion, and are subject to none of the blights, parasitic insects and fungi, that infest our orchards, so that one need not fear to eat an apple in the dark. Strawberries may be bought in the San Francisco market every month in the year. It is not easy to name any fruit which will not ripen within the limits of the State. At Sonoma, on the grounds of General Vallejo, the old Spanish commandant of California, I saw ripe or ripening, along with all the common fruits of the temperate zone, oranges, lemons, bananas, olives, figs and almonds. I have eaten olives in Italy, but never any so good as those from the General's own trees on which I lunched at his table. In the southern part of the State, cotton is rapidly becoming a staple, and coffee, equal to the best St. Domingo, is already raised. The cultivation of tea has been commenced with the promise of complete success, and there is no reason why the spices of the East Indies should not become naturalized there.

There is also in the interior a supply of lumber of all kinds which it would take many centuries to exhaust, though as yet, for lack of available avenues for transportation, lumber for the cities on the coast is imported from Oregon. If every schooner, sloop and sail-boat in the world were a

ship of three thousand tons, I saw, on a single day's ride, enough pine trees from one to two hundred feet high, straight as an arrow, to furnish masts for all the vessels in the world, without perceptibly thinning the primeval forest.

The climate is unequalled in salubrity. In San Francisco a sea-breeze sets in from the ocean at three or four o'clock on a summer afternoon, rendering the air rather cooler than suits one not acclimated; but this is not experienced in the winter, and the average temperature of the winter is rather higher than that of the summer. Only a few miles from the coast the force of the ocean-breeze is spent. There the summer days are very hot, but the air is so pure that the thermometer of one's own consciousness is much below Fahrenheit's, and I found it as easy to take a long and brisk walk at the temperature of a hundred degrees, as it would be in New England at seventy-five. The night air is inexpressibly sweet and mild, so that one would not care whether he lodged within doors or under the star-gemmed roof. It is no uncommon thing to have the windows of lodging apartments taken out, and laid aside as useless, from the early spring till the autumn. The atmosphere, even in midsummer, is so entirely free from malaria, that lamb or veal hung up in the open air will dry before it becomes tainted; and outside of farmhouses and hotels we often see, suspended on trees, locked safes covered with wire-gauze, in which fresh meat may be preserved sound and sweet for several weeks.

For seven or eight months in the year rain never falls. The grass, indeed, looks brown; but the trees, which strike their roots down into soil still moist, retain their verdure, and for the various crops of grain and vegetables artificial irrigation is extensively employed, — windmills for raising water being used, not only on farms, but in orchards, and often in private gardens. The whole country is diversified by gentle elevations — foot-hills, as they are called — which generally furnish perennial fountains that are led among the valleys, unfailing sources of fertility and wealth. The cli-

mate facilitates the labor of harvest. The wheat and grain are threshed on their native field, bagged, and piled up against the fences till a convenient time for carrying them to market; and I often saw such huge piles of bagged wheat and oats, that it required some stretch of fancy to imagine that it could all have grown in a single year within the area of the field.

NOTES ON SOME BIRDS IN THE MUSEUM OF VASSAR COLLEGE.

BY PROFESSOR JAMES ORTON.

The Ornithological Cabinet in the Vassar Museum, contains nearly twelve hundred distinct species, of which seven hundred are North American, and the remainder South American. Among them are several type specimens and others of historical interest as the originals of Audubon's celebrated drawings.

Falco islandicus Gm. This fine specimen formerly belonged to Audubon, to whom it was presented by Sir John Cheperstal, and is the original of the figure in "Birds of America."

Accipiter nigroplumbeus Lawr. Type. This new hawk was obtained by the writer in the Valley of Quito, where it is very rare.

Strix punctatissima Gray. Indigenous to the Galapagos, but now rather abundant in the Valley of Quito near the cotton-mills of Chillo, where it is called "Factory Owl." It lays nearly spherical eggs, in a rude nest made of a small quantity of rubbish scraped together and lined with a few feathers, and generally built in the gable ends of houses or under the eaves.

Trogon Mexicanus Sw. The late Mr. Giraud informed us that this specimen was shot in Texas. The Trogon fam-

ily is well represented in the East Indies; but it is more fully developed in the New World where there are about twenty-five species. In splendor of plumage they are surpassed only by the Hummers; in stupidity, by the Jacamars. Their only utterance sounds like *Te vio!* (I see thee). They are zygodactylous, but unlike the woodpeckers and parrots, the third or longest toe being the inward of the two forward toes instead of the outward.

Andigena laminirostris Gould. This rare bird represents a remarkable group of Toucans characterized by the dense villose clothing of the under surface. This species is found at Nanegal on the west slope of the Andes; not in the neighborhood of Quito, as stated by Mr. Gould. The Toucans, of which thirty-five species occur at the equator, are confined to tropical America. They live in dense forests in small companies. Their flight is laborious but not jerky. On the ground they hop like a robin. They have a shrill though variable cry, which sometimes has a vague resemblance to *tocáno*, and again to *pia-po-o-co*. The imaginative natives call them Preachers, because they seem to make the sign of the cross by wagging the head up, then to the left, next to the right, and finally down, saying at each movement *Dios tode* (God gave it you). The sexes are exactly alike. The most common species on the Upper Amazon are *Cuvieri*, *Humboldtii* and *pleuricinctus*.

Tetragonops ramphastinus Jard. This singular Barbet is called by the natives *venenero* or deer-hunter, because it whistles with ventriloqual powers. None of the Capitonidæ sing. The phlegmatic Buccos or "pig-birds," as the Indians call them, seem to have their head-quarters in Eastern Peru. The Tetragonops is a connecting link between the Barbets and Toucans.

Lesbia Ortoni Lawr. Type. This remarkably fine species is the latest addition to the Trochilidæ. It was discovered in the Valley of Quito at the foot of the isolated mountain Ilalo, and is the only specimen ever found. The

superstitious Indians who inhabit Ilalo are very exclusive, forbidding the approach of any white man to their mountain; and for this reason, probably, this Hummer has never before been seen. The collection contains one hundred and twenty-six species of Trochilidæ.

Chætura rutila Vieill. This elegant little Swift or "Nocturnal Swallow" was obtained in the Quito Valley, where it is very rare. Vieillot's type was found in Trinidad; Lafresnaye's specimens were from New Grenada; and Salvin procured them in Guatemala, where Sclater says it properly belongs. Its nest is not made of mud and sticks like that of its northern representative, our chimney swallow, but chiefly of moss, very compact and shallow, and located in dark culverts about two feet above the water; never on houses or trees.

Brachygalba lugubris Sw. RE-DISCOVERED TYPE. Since this Jacamar was first described in 1838, not a single specimen has come under the notice of any naturalist; and in 1853, Mr. Sclater declared that Swainson's bird remained to be re-discovered. This specimen was shot by Mr. Gilbert at Valencia in 1867, and has been recognized by the distinguished ornithologist, George N. Lawrence, Esq., as the lost *lugubris*. The only discrepancy from Swainson's description is the possession of four toes instead of three; but the hind toe is quite small. It is distinct from *B. inornata*. Jacamars stand next to the Trogons and Hummers in the beauty of their golden-bronze, and steel-colored plumage. They are peculiar to tropical America, and Guiana is their true home. None have been seen on the west slope of the Andes.

Todirostrum gracilipes Scl. The type in the British Museum came from Bogota; but this specimen was obtained by Hauxwell on the Upper Amazon. From the same locality we have the *Empidomus varius*.

Myiarchus Lawrencii Gir., *Basileuterus Belli* Gir., *B. Brasieri* Gir., *Dendroica olivacea* Gir., and *Cardellina rubrifrons* Gir. The types of these species formerly belonged

to this cabinet, but are now in the Smithsonian Institution, and are replaced by other specimens collected by Sumichrast, Salvin and Verreaux. To the day of his death, Mr. Giraud contended that the types were collected within the State of Texas.

Myiozetetes inornatus Lawr. TYPE. From Valencia, Venezuela.

Turdus Hauxwelli Lawr. TYPE. From Pebas, Peru.

Dendroica tigrina Gm. This handsome specimen was shot by Wilson in the vicinity of Cape May, 1812, and was described by him as a new species. Gmelin, however, in 1788 had named it *Motacilla tigrina*.

Euphonia elegantissima Bp. Our specimens do not conform to Sclater's description: the throat of the male is not "black," but bluish black like the back; the forehead is not "chestnut, margined behind with black," but is bright yellow.

E. nigricollis Vieill. This Tanager is one of the best songsters in the Valley of Quito; the other birds only twitter and chirp; like the people, too lazy to sing. The *Mimus lividus* is its rival in Brazil. The Tanagers generally have no melody of voice. They are restless, wary birds, having a rapid, abrupt flight, and seldom hopping on the ground. They are most numerous in New Granada, and the most important genus is *Calliste*. To the puzzling question, "What is a Tanager,?" Sclater answers, "a dentirostral Finch." At Quito the Finches build their nests in October.

Atticora fasciata Gm. This type of the genus is described by Baird as having ten tail feathers: both male and female in the Vassar collection show twelve. They are from the Maranon.

Pipra deliciosa Scl. One of the most brilliantly colored of the Manakins, the male being also remarkable for the singular structure of its wings, the secondaries being curved. By the natives it is called "Watchman," because it flies before certain blue birds, and makes a noise with its wings in case of danger.

Diglossa aterrima Lafr. The natives say that it changes its colors if taken to Pichincha, becoming like *D. Lafresnayi*.

Rupicola sanguinolenta Gould. This splendid "Cock of the Rock" is found only, we believe, on the western Andean slope. The *R. Peruviana* is confined to the eastern slope, and the *R. crocea* to the mountains of Guiana. It frequents shady ravines and is very shy. It "plays 'possum," falling apparently dead when shot at, but soon flies off. It makes a guttural noise not unlike the grunt of a hog. Like the Bird of Paradise, Peacock, Turkey, etc., the Cock of the Rock makes an extraordinary display of its finery just prior to the breeding season.

Chrysomitris Mexicana Bp. TYPE of *Fringilla Texensis* Gir.

Ocyalus latirostris Sw., *Clypicterus oseryi* and *Amblycersus solitarius*. These splendid specimens of Icteridæ were obtained on the Upper Amazon, where they appear to be rare.

Icterus Grace-annae Cass. This seems to be the only specimen found since its description. The type is in the Philadelphia Academy. This fixes the locality (Machala near Guayaquil), which was not positively known.

Cephalopterus ornatus Vieill. This Umbrella Bird came from the Upper Amazon. It was formerly thought to be confined to the islands in the Rio Negro. It is found only on the eastern side of the Andes; the *C. penduliger* being restricted to the western slope, and *C. glabricollis* to Central America. The throat lappet of *penduliger* is nearly ten inches long; that of *ornatus* about four, and of *glabricollis* insignificant. According to Fraser, the appendage seems generally held in a bunch like a rose under the throat, and to fall after death.

Chlorœnas vinacea and *Ortolida guttata;* from the Upper Amazon. Near Savonita on the west slope of the Andes is an Ortolida whose note sounds like *trabajá, trabajá* (work! work!), and the response of the answering bird is *manana, manana* (to-morrow), a parody on Spanish character.

Meleagris ocellata Temm. A pair, male and female, in fine plumage.

Lophortyx Gambelii Nutt. Of this bird, "whose rarity is only equalled by its beauty" says Gould, there is a pair in perfect condition.

Demiegretta Pealii Bp., *Garzetta candidissima* Gm., *Florida cæruba* Linn., and *Ibis alba* Linn. These specimens once belonged to Audubon, from which he made the drawings for his large work.

Platalea ajaja Linn. This specimen was obtained of Dr. Trudeau. It was shot on the plantation of his father near Charleston, S. C.

Aphriza virgata Gm. TYPE of Audubon's *A. Townsendi*, from the mouth of Columbia River; the only specimen obtained within the bounds of the United States. Properly belongs to the Pacific Islands. Professor Baird doubts its occurrence on the shores of the northern Pacific, but Dr. Sclater does not. Several have been found on Vancouver's Island.

Phalaropus Wilsonii Sab. A superb specimen in Bell's best style of mounting.

Anser Gambelii Hart. Original of Audubon's drawing.

Bernicla leucopsis Linn. Original of Audubon's drawing.

Somateria spectabilis Linn. Specimen shot on Long Island Sound!

Sterna Trudeauii Aud. TYPE. The original of Audubon's figure and description; shot at Great Egg Harbor. According to Mr. Giraud, the only specimen found in North America. It is in full plumage.

Colymbus arcticus and *C. septentrionalis* Linn. Originals of Audubon's drawings.

Podiceps occipitalis Less. This grebe was found by the writer on Lake Mica, which is on the side of Antisana, Ecuador, 13,300 feet above the Pacific. It appears to be identical with the species abounding on the coast of Chili and Straits of Magellan. It is difficult to conceive how this

purely aquatic bird could or would ascend and cross the western Cordillera, and then ascend to an icy, solitary lake on the shoulder of one of the loftiest volcanoes in the eastern range, 2,500 miles from its native place. Forbes found *Cyclas Chilensis* (formerly considered peculiar to the most southern and coldest part of Chili at the level of the sea) abundant in fresh-water ponds in the Bolivian plateau near La Paz, 14,000 feet high. Do not these facts point to changes in the Andes on a grand scale, and at a rate which, measured by the time required for a change of species, must be termed rapid ?

Alca impennis Linn. Original of Audubon's figure. A notice of this specimen was published in the *American Naturalist*, 1869.

Mormon cirrhata Pall. Original of Audubon's figure.

Phaleris cristatella Pall. Original of Audubon's figure.

FURTHER NOTES ON NEW JERSEY FISHES.

BY CHARLES C. ABBOTT, M.D.

Fig. 163.

Hybognathus.

DURING the month of February of the present year (1870), Professor George H. Cook, State Geologist, sent to the author of this paper a number of "frost-fish," or "smelt" (*Osmerus mordax*), and among them was the single specimen figured above. On submitting this cyprinoid to Pro-

fessor Cope of Philadelphia, he pronounced it undescribed, and has since described it* as *Hybognathus osmerinus.*

During the past summer the author had no opportunity of fishing in the Raritan River, at or about New Brunswick, at which point the specimen was taken; but among a number of small collections from that river, no specimen of this cyprinoid occurred. From other streams, generally not in the basin of the Raritan, isolated specimens have occurred, and the distribution seems to be without reference to salt water, although the type, and two other specimens, were taken from streams having direct access to the sea.

Of its habits, as yet, we have determined nothing; only learning from the specimens we have seen, that it seems to be very scarce, and associated by twos and threes with other cyprinoids, more especially with *Hybopsis Hudsonius*, which is very abundant in many of our smaller streams, as well as the Delaware River.

During the month of August of this year, the writer found a locality for two species which are not abundant elsewhere, so far as his own observations go to show. These fish are an etheostomoid (*Hololepis erochrous* Cope), and a "cat-fish" (*Noturus gyrinus*). They were both found abundantly in Stony Brook, Mercer Co., N. J., near the village of Princeton. The stream here is shallow, with a muddy bottom, and here and there a flat stone or two, under which both species took refuge when disturbed. On approaching the brook, the fish were found to be lying on the mud, near the edge of the stream, in water scarcely two inches deep. The movements of the etheostomoids were very deliberate, as they usually moved very slowly, making straight lines on the mud, apparently by not lifting themselves from the bottom of the stream. By placing a small baited hook immediately in front of the "darters," they would seize it with all the rapidity and voraciousness of a pike, and upon swallowing it,

* A Partial Synopsis of the Fishes of the Fresh Waters of North Carolina. By Edward D. Cope, A.M. Amer. Phil. Soc., Phila., 1870, p. 466; *foot note.*

would invariably be taken. The writer took nearly fifty specimens with a hook, in about two hours. The "stone-cat-fish" were much more active, and shy; and would not take the hook, until after an immense deal of nibbling trying to the patience.

While collecting specimens in Stony Brook, as mentioned above, the writer met with a nearly exhausted eel, into the left gills of which, a lamprey (*Petromyzon nigricans*), had inserted its sucking apparatus. The eel had drawn the lamprey by the suction power of the gill, into its throat, and having thus killed the lamprey, was itself nearly dead from endeavors to get rid of so great an incumbrance. In the stomachs of both the eel and the lamprey, were found masses of partially broken shells of minute *Lymneæ*, showing (circumstantial evidence) that they had been occupied in feeding upon the same food on the same ground, when the lamprey made his unfortunate attack upon the eel. Has it been noticed before, that the lamprey feeds upon small shells?

Two specimens of *Aphrodederus Sayanus*, were taken in Stony Brook, during the summer, and have been since kept alive in an aquarium. Soon after their capture, and since, one of them has exhibited the following "freak of coloration." The specimens, while lying on the pebbles at the bottom of the tank, were each of a glossy black, relieved by a pale brown throat, well dotted with black; and with a snowy white margin to the caudal fin. They were removed by a small net, to another tank having somewhat colder water in it, and immediately one of the pair became of a uniform pale straw color, except the black dots on the throat, and a narrow line running from the lower edge of the orbit to the jaw. The white margin of the caudal fin was scarcely distinguishable from the general color of the fin and body. The iris became silvery, with a mere trace of yellow. In the course of half an hour, the tints commenced to grow deeper, and full two hours elapsed before the usual black hue was resumed and the two specimens became similar in appearance.

Had this specimen thus "bleached" on being removed from one tank to another, done so on being taken wholly from the water, and, thus faded, had been preserved in alcohol, might it not have been looked upon as an *Aphrodederus albidus* nov. spec., and thus additional synonomy been offered to the confusion now existing? Is it, in fact, safe to consider color as of *any value* as a specific character, unless by comparing many specimens, and finding the variation uniform and without gradations? We have found the "sun-fish" as a group, to vary very much in accordance with the character of the stream in which they were found; and in an aquarium the "banded sunfish" (*Mesogonistius chætodon* Gill), is verily kaleidoscopic. The black bands actually sometimes *wholly* disappear!

THE SPORES OF LICHENS.

BY H. WILLEY.

THE importance of the spores in the study of lichens, will perhaps render interesting a more extended reference to this branch of lichen history. The spores were known to Micheli, who figures those of several species in his "Nova Genera Plantarum," 1729, as did also Acharius in his "Lichenographia Universalis," 1810. But he made no use of them in his system. The great work of Fries, "Lichenographia Europæa Reformata," 1831, has no reference to the spores, excepting a few remarks in regard to their germination; but Eschweiler in the same year, made a somewhat careful examination of them, and noticed their various forms, although he endeavored in vain, he says, to make use of the spore-case in distinguishing genera. Fée, in the supplement to his "Essai," 1837, was the first to do this, and to figure and describe accurately the spore-cases and spores. But

De Notaris in 1846, from which period Krempelhuber dates the modern period of Lichenology, fully inaugurated the new method, and established it on a solid foundation. He pointed out the unity of the spore-type in many natural genera, and declared that species in which the spores presented important differences could not be grouped together. But the results of his labors do not appear to have been combined into a general system. Norman, in Norway, 1852, Massalongo, in Italy, 1852, and Koerber in Germany, 1854–1859, continued his work, and based their systems to a greater or less degree, on spore characters, while the younger Fries, Trevisan, Stitzenberger and others have labored successfully in the same field, and made important contributions to this department. No description of a lichen is now considered adequate which does not give an account of the spores, when they are to be found.

The Italian school, however, has attributed too great importance to minor distinctions in the size of spores, their septation, and number in the spore-case, attaching great importance to micrometric measurements, and thereby increasing the species and genera to a most unwarrantable degree, and not unfrequently violating natural affinities, answering no useful end and tending rather to create confusion than to advance true science. A few instances may serve to illustrate this. *Pyrenula nitida* Schær. is a very common bark lichen, and subject to but slight variation. The average length of the spores is from .018 to .022 millimetre; but specimens occur, which cannot be separated from it, in which they measure constantly from .030 to .038. *Arthonia velata* Nyl. is another instance in which the spores in some specimens are constantly nearly twice as large as in others. The spores of *Sagedia chlorotica* Ach. are described in the European forms as constantly 4-blastish, measuring from .018 to .023. Here they are usually from 4 to 6-blastish, and measure from .025 to .047, and it is only recently that I have found specimens with constantly 4-blastish spores, a

little smaller than the European, and measuring from .014 to .020. *Sagedia cestrencis* Tuck. is another example, though I am doubtful whether my specimens are different from *S. carpinea* Pers. As it occurs on the beech, the spores are fusiform, and measure from .034 to .038, while those on the hemlock, referred to the same species, are acicular and from .072 to .118. But perhaps the difference in form would justify making this a distinct species. *Rinodina sophodes* Mass. and *Biatora rubella* Fr. are two very variable species, but specimens referred to each vary in the former from .010 to .025, and in the latter from .018 to .075.

So in regard to the number of spores in the spore-case. The form of *Rinodina sophodes* in which the spore-cases contain twelve or more spores, can hardly be distinguished from that in which there are only eight, though Th. Fries makes it a separate species, under the name *R. polyspora*. I have found specimens of *Buellia microcarpa* D. C. which do not differ from the common form more than the two forms of *R. sophodes*, but in which there are from eight to sixteen spores in a spore-case; and a parasitic lichen on the thallus of a Saxicoline *Pertusaria* which appears to differ from *Buellia parasitica* Flk., only in the spore-cases containing a large number of spores. These examples might be numerously increased, but they are perhaps sufficient to show that too much importance should not be attached to what Professor Tuckerman calls "mere *gradal* differences."

Nylander, the great French lichenist and the antagonist of the German-Italian school, does not seem to attach sufficient importance to the differences in spore characters. In his remarks in his "Synopsis" on specific characters in lichens, he contents himself with a few indefinite observations in regard to them, and in his classification makes no generic distinctions based on form or color. Thus Rinodina is included under Lecanora, and Buellia under Lecidea. Indeed he seems to consider the spermatia as more important classificatory organs than the spores. In his descriptions, however,

he gives the forms of the spores, though not always accurately, and their measurements. While the Italian and German writers on the one hand tend to too great a subdivision of genera and species, Nylander, on the other, is frequently too comprehensive, though this is perhaps the safer error of the two.

Professor Tuckerman of Amherst, has expressed briefly his views on the value of spore characters, in his "Lichens of California," 1866, and has laid the foundation of a more sound and instructive doctrine on this subject than previous writers. In his opinion, which has been followed in what precedes, "less weight than has often been assumed should be given to spore differences of a merely gradal character, or such others as depend only on mensuration, and more to those that seem typical." He considers that there are "two well defined kinds of lichen-spores, complemented in the highest tribe only by a well-defined intermediate one. In one of these (typically colorless) the originally simple spore, passing through a series of modifications, always in one direction, and tending constantly to elongation, affords at length *the acicular type*. To this is opposed (most frequently but not exclusively in the lower tribes, and even possibly anticipated by *the polar-bilocular sub-type* in *Parmeliacei*), a second (typically colored) in which the simple spore, completing another series of changes, tending rather to distension and to division in one direction, exhibits finally *the muriform type*." In accordance with this view Rinodina is distinguished from Lecanora, and Buellia from Lecidea. *Theloschistes parietinus* is separated from Physcia, a genus with colored spores, and placed in a distinct genus, the type of whose spore is the *polar-bilocular*. On the other hand *Biatora rubella* would not be separated from that genus, which includes species with simple spores, merely on account of its septate spores, nor *Buellia petræa* placed in a distinct genus, Rhizocarpon, on account of its muriform spores, nor *Lecanora cervina* on account of its polysporous

spore-cases. It is to be observed, however, that the typically colored spore is often, as Professor Tuckerman expresses it, decolorate. Thus the spores of *Buellia petræa*, are often, and always, so far as I have observed, in a form which occurs on rails, colorless, and frequently only 2-blastish. Similar conditions also occur of *Rinodina sophodes* and *R. ascociscana*. *Pertusaria* is another genus in which the spores should probably be considered as typically colored. They are usually of a yellowish tinge, and in one specimen of *P. leioplaca* they were of a rich golden brown. There are many genera in which species with spores belonging to the typically colored series, have spores always, so far as observed, colorless, or "decolorate." In the genera of all the great families of lichens will be found spores corresponding to these various types; and a table might be constructed, showing the analogies throughout. But into the subject of lichen classification it is not my purpose here to enter.

Our illustrations in the preceding number of the NATURALIST show the different types of spores as thus distinguished; those of *T. parietina* being polar-bilocular, those of *Biatora rubella*, acicular, and those of *Buellia petræa*, muriform. The adoption of this idea will certainly introduce an order and clearness into lichenology which it has hitherto lacked, and will do away with a host of genera of the German and Italian writers, which serve only to encumber the books and to embarrass and confuse the student. There are perhaps some exceptions, as Professor Tuckerman admits, in regard to Gyalecta, and as is perhaps the case also with Arthonia. But these may disappear with further knowledge, and we have to thank the Professor for an idea which greatly simplifies a difficult study, and whose advantages, as he justly remarks, far outweigh its difficulties. He has promised a further discussion of the subject in his forthcoming work on the Genera of North American Lichens.

THE SPERM WHALES, GIANT AND PYGMY.

BY THEODORE GILL, M.D., PH.D.

Vastness of size is so generally, and it may almost be conceded, so naturally associated in the popular idea with the whales, that some may scarcely be able to realize at first the fact that there are species no larger than ordinary porpoises; and yet which agree so closely in all the more essential elements of structure with some of the whales, that it is impossible, in a natural system, to separate them far from their gigantic relatives. We say *some* of the whales, for it is to be observed that the animals which are designated popularly as whales do not form a natural group, as contradistinguished from other animals. As popularly applied, the word whale is a designation used in common for all the gigantic cetaceans, whether they be toothless and furnished with whalebone, as are the right-whales, or whether they be toothed, as are the sperm-whales, or cachalots.*

The pygmies, to which we have alluded above, would not answer, then, to the popular conception. But, indeed, there are no characters which are coördinated with size, and which would enable one to give a definition other than relative to size. We have to enter upon a more profound examination before being able to ascertain the relations of the various members of the cetacean order. It is only by taking into account the sum total of characters, internal as well as external, that we are at length enabled to arrive at a correct appreciation of the true affinities of animals, and this inductive mode of study, applied to the cetaceans, teaches us that

* It should be added, however, that "whale" seems to be used by some whalemen as a quasi-generic term for the cetaceans (see Cheever, "The Whale and his Captors," pp. 96, 97), and is also applied by other persons to some of the larger *Delphinidæ*, such as *Beluga* (the white whale), *Orca* (the killer whale), *Globiocephalus* (the caing whale), etc.

in the order are two great groups, which, we may at once add, are suborders; and that these groups are distinguished from each other by numerous characteristics: the most apparent of these are, in one group, (the MYSTICETE,) the development of whalebone on the roof of the mouth, and the entire want of teeth,* — they being reabsorbed into the gums before birth,—the development of an olfactory organ, and of nasal bones free at their distal ends; and in the other group, (the DENTICETI,) the absence of the whalebone, and the development of teeth after birth generally persistent in one or both jaws during life, but in some forms more or less early deciduous; the olfactory organ is atrophied, and the nasal bones are appressed to the frontals and overlapped by the vomer.

It is not in one alone of these groups that we find associated together, in a natural morphological combination, giants and dwarfs, although only in one do we find the contrast in the present age of our globe. It is the family of *Physeteridæ* (the sperm-whales) which furnishes us with the contrast in living forms; only giants are now living to represent the *Balænidæ* (the right-whales), and *Balænopteridæ* (the fin-back whales), but in the miocene age, a species of a fin-back whale lived that when adult was not even as large as the *new born young* of the fin-backs now living.† It is, however, only with the pygmy sperm-whales, equally small or even smaller, compared with their gigantic relatives,‡ that we will now concern ourselves. And we will commence our study with the enquiry as to what are the essential characters of the family to which they belong. Our task is ren-

* Teeth are present, however, in the fœtus, but are not functionally developed.

† See Cope in Proceedings of the Academy of Natural Sciences of Philadelphia.

‡ Beale, a trustworthy observer, has recorded the capture in the "Japan Fishery" of a male cachalot eighty-four feet long; J. D. Bennett has remarked "that the largest size authentically recorded of the sperm-whale is seventy-six feet in length, by thirty-eight in girth; but whalers are well contented to consider sixty feet the average of the largest examples they commonly obtain." Professor Flower, after a critical study, concluded that the length might be about sixty feet, and "ventures to question whether the cachalot frequently, if ever, exceeds that length, *when measured in a straight line.*" The adult *Kogiinæ* attain a length of from seven to eleven feet.

dered easy by the recent publication of a very elaborate monograph "On the Osteology of the Cachalot or Sperm-whale (*Physeter macrocephalus*)," by Professor Flower of the Royal College of Surgeons of England, and a full description and illustrations of a pygmy whale, by Professor Owen, who has been the first to clearly elucidate the details of structure of a member of the group of small species.

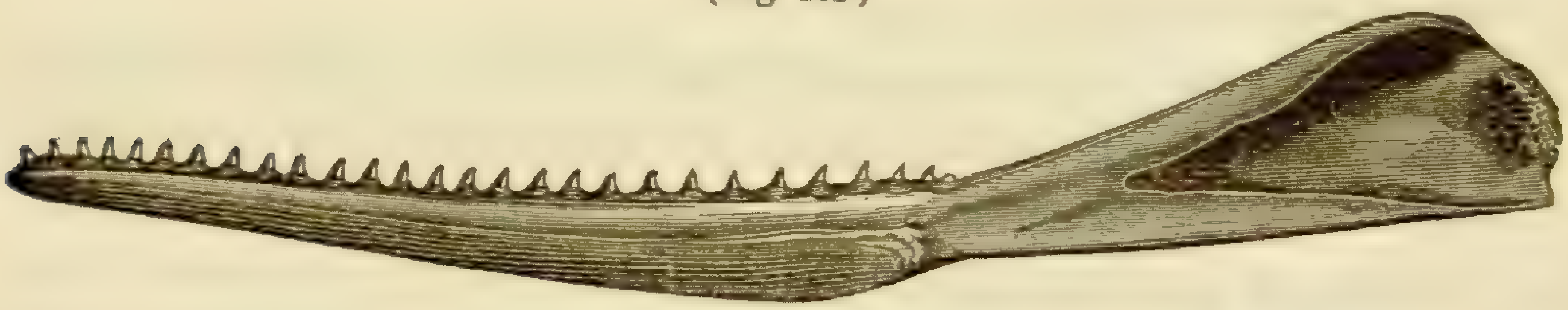
1. *Families of Toothed Cetaceans.* There are four families of toothed cetaceans: the *Physeterids*, or sperm-whales; the *Ziphiids*, nearly allied to the former, but in some respects approaching nearer to the *Delphinids*; the *Platanistids*, containing mostly fresh-water forms; and, finally, the *Delphinids*, containing by far the largest number of genera and species, and embracing the dolphins (not the fishes of that name), the porpoises, etc. It is on a comparison between the members of all those families that the following characters are shown to be peculiar, either absolutely or in combination, to the Physeteridæ.

2. *Common Character of Sperm-whales.* The form is variable, the head being either disproportionately large and blunt in front, with a subterminal blower, as in the giant whales, or conical, as in the dwarfs; the snout, however, always projects forwards, and the mouth is inferior. The cervical vertebræ in whole, or the atlas excepted, are anchylosed together. The hinder ribs lose their heads, and are only connected by their tubercles with the transverse processes of the vertebræ. The costal cartilages which connect the ribs with the sternum retain more or less of their original cartilaginous condition. The skull has the bones raised so as to form a more or less elevated retrorsely convex crest behind the anterior nares. The supraoccipital (*so*) and parietals combined extend forwards on the sides, and present a convex border projecting forwards high above the temporal fossa, and forwards beyond the vertex. The frontal (*f*) bones have an extended lateral surface deflected downwards and produced upwards, exposing to view

a triangular or *retrorsely* falciform wedge between the maxillaries and supraoccipital. The left nasal bone (n) is atrophied; the right hypertrophied and twisted to the left side. The jugal (j) is well developed and projects downwards or backwards. The orbit is small or of moderate size. The pterygoid (*pt*) bones are thick, produced forwards and entering largely into the bony roof of the mouth over and behind the palatine (*pal*) bones, not contiguous at the middle, with low ridges on the oral surface diverging more or less backwards and outwards, and with sides not involuted so as to form the outer wall of the postpalatine air-sinus. The lower jaw has a more or less elongated symphysis. Teeth are functionally developed only or chiefly in the lower jaw. The pectoral limb is small.

3. *Deductions.* Such are the characters possessed by all the members of the family. It will be observed that all but

(Fig. 164.)



Lower Jaw of *Physeter macrocephalus*, from Flower.

one of them which are truly distinctive are derived from the internal organization, and as some persons may complain of this and ask why external characters have not been employed, it may be added that there *are no* distinctive external features, except the inferiority of the mouth, and that only owes its importance to its coördination with others. It cannot be too often repeated that our judgment respecting the relations of animals is only reliable when based on the most complete and comprehensive examination of the entire structure, external as well as internal, and that one of the first elements of a natural classification is that the characters used shall be at least expressive of the sum of all the common characters.

In order now to exhibit the relative importance of the characters and their subordination, it may simply be stated that the chief, or at least most salient peculiarities in the form and relation of the bones are those exhibited by the supraoccipital in combination with the parietals, and also those presented by the frontals. In these respects, the sperm-whales stand alone among the cetaceans, while the Ziphiids, to which they are most nearly allied, and with which they agree in the costal cartilages, the form of the pterygoids, etc., resemble the Delphinids in the development of those bones.

4. *Differences among Physeterids.* Having now pretty carefully passed in review the common characters of the Physeterids, we may now enter on an examination of the subdivisions which are indicated by a similar course of study. After a detailed investigation of all known forms it is found that they may readily be grouped into two divisions which are separated from each other by many striking peculiarities. One of these is represented by the large species; the other by small ones; for the former, has been retained by the best naturalists the Linnæan name *Physeter;* for the latter, was first proposed the Grayan name *Kogia*, a barbarous designation which has by some been superseded by *Euphysetes*. In order to exhibit at once the contrast between the two forms, and to facilitate comparison, we append the characters in parallel columns.

PHYSETER.	KOGIA.
Form massive, with the head very large, oblong in profile and truncated at the front; eyes very small, very low, and near the angle of the mouth; blow-hole anterior, and at or near the edge of the truncated snout.	Form delphinoid, with the head conical, the snout being attenuated and projecting beyond the mouth; eyes moderate, nearer the forehead than the angle of the mouth; blow-hole at the forehead.
Dorsal fin represented by a hump.	Dorsal fin falcate.
Cervical vertebræ differentiated into an atlas and a combination of the second to seventh anchylosed and fused together.	Cervical vertebræ all united by anchylosis.

Ribs about ten or eleven pairs in number.	Ribs about thirteen or fourteen pairs in number.
Skull abruptly contracted into the attenuated rostrum, which equals or exceeds three times the length of the condylo-orbital line; above, semi-circular behind; with the rostral part oblong and acute conic.	Skull gradually sloping into the rostrum, which is shorter than the condylo-orbital line; above, reniform behind; with the rostrum obtusely conic.
Cerebral cavity declining downwards.	Cerebral cavity inclining upwards.
Occipito-sphenoid axis angular; the basioccipital portion very declivous or almost perpendicular, and the anterior part of sphenoid portion inclining upwards.	Occipito-sphenoid axis continuous upwards from the thickened horizontal floor in front of the foramen magnum.
Basisphenoid (*bs*) and palatines (*pal*) not or scarcely visible from the side, being concealed from view by the exoccipitals and squamosals.	Basisphenoid and palatines curved downwards and outwards, and largely exposed to view from the sides.
Frontal (*f*) with the exposed surface broadly triangular above between the supraoccipital and maxillaries; curved inwards behind the postorbital process; the process is very distinct.	Frontal with the exposed surface retrorsely curved above; with an angulated margin above the temporal cavity.
Squamosal (*s*) with an external oblong triangular surface, and with a zygomatic process for articulation with the jugal; contributing little surface to the floor of the temporal fossa.	Squamosal with a small, external surface, but a large incurved surface, forming the largest portion of the periphery of the temporal fossa.
Jugals (*j*) inclined backwards, and articulated with zygomatic processes of the squamosals.	Jugals inclined downwards and remote from the squamosals.
Nasal (*n*) bone flat, smooth.	Nasal bone with a thickened sigmoidally sinuous ridge continued from the nasal septum to the vertex, and with a less defined branch extending from its posterior part forwards on the right intermaxillary.

Maxillaries (m) continuous, the contour being simply interrupted by the anteorbital notch; the anterior portion very long, high, wide, and carinate at its proximal half; the posterior portion simply declivous on the frontals.

Maxillaries differentiated into two portions by the deep anteorbital notch; the anterior short, low, narrow, and ecarinate; the posterior portion with a thickened external contour.

Intermaxillaries (i) very elongate, nearly contiguous anteriorly, and projecting forwards considerably beyond the maxillaries.

Intermaxillaries very short, diverging forwards on account of the development of the vomer; not or little extending beyond the maxillaries.

Lower jaw with the symphysis nearly co-equal with the alveolar region, and more than half the length of the rami.*

Lower jaw with the symphysis little more than half as long as the alveolar region, and less than a third the length of the rami.

5. *Deductions Respecting the Relative Value of Differences.* Thus have we in considerable detail contrasted the respective peculiarities of the two groups of Physeterids. We have gone into such detail, as it is only in that way that we can appreciate the great difference between the two. The question now arises, what is the value of those groups? Are they simply genera? or are they entitled to higher rank?

On account of the limited number of species, and the close relationship of the several members of the respective groups, we are compelled to judge somewhat by analogy, and comparison with allied families. As the result of such comparisons, especially among the representatives of the families *Ziphiids* and *Delphinids*, it is believed that the value of several characters above given is of more than generic value, the difference appearing to be very much greater than exists between genera in either of those families, and it is there-

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* Our readers residing in Boston and its suburbs can verify the characters of *Physeter* by a visit to the Museum of Comparative Zoology, at Cambridge, belonging to which establishment are the skull and parts of the skeleton of an individual obtained, we believe, on the coast of New Jersey.

It may be remarked here that some fossil remains from the Miocene of the Eastern United States have been referred to the *Physeteridæ*, with the names *Orycterocetus cornutidens* Leidy, *O. crocodilinus* Cope, and *Ontocetus Emmonsii* Leidy; and some from the Pliocene, as *Physeter antiquus* Leidy.

fore proposed to designate the genera *Physeter* and *Kogia* as representatives of two sub-families of PHYSETERIDÆ, to be respectively designated as PHYSETERINÆ and KOGIINÆ. If we are called upon to make a distinction between sub-family and generic characters, it is believed that the most important are the form of the head (a difference of greater moment than analagous ones among the Delphinidæ) and position of the blow-holes, the form and direction of the cerebral cavity and coördinate modification of its enclosing bones; the direction of the occipito-sphenoid axis, and the form and relations of the jugal and zygomatic processes of the squamosal bones.

And lest some may entertain a suspicion that some of the differences above enumerated may be the result of vegetative growth (or bulk) in *Physeter*, it is proper to add that the young of that form essentially resembles the adult, and that the characters enumerated are as applicable to the one as to the other. Nor are the characteristics of *Kogia* the expressions of arrested development; they are special modifications, and the form itself is quite as specialized a type as is *Physeter* itself. Both forms, so far as known, have equally lost the evidences of the nature of their common progenitor, and it is impossible to decide, from present facts, which is the most divergent from the common stock. If we were to be guided by consideration of size, *Kogia* would seem to be the most divergent, the typical *Physeterids* and related *Ziphiids* being all large animals, but such hint would probably be illusive *per se*, although really perhaps near the truth.

6. *Subdivisions of the Family.* While the first subdivision of the family into two subfamilies based on tangible and reliable data, is that presented in this article, a binary division had been previously proposed by Dr. J. E. Gray, in the "Additions and Corrections" of his "Catalogue of Seals and Whales in the British Museum," published in 1866; therein (p. 386), he subdivides the family as follows:

I. *Head compressed, truncated in front. Blowers in front of the upper part of the head. Skull elongate. Dorsal hump rounded. Pectoral fin short, truncated.* Catodontina.

1. Catodon. The atlas oblong, transverse, nearly twice as broad as high; the central canal subtrigonal, narrow below.

2. Meganeuron. The atlas subcircular, rather broader than high; the central canal circular, in the middle of the body, widened above.

II. *Head depressed, rounded in front. Blowers at the back of the forehead. Mouth small, inferior. Dorsal fin compressed, falcate. Pectoral elongate, falcate.* Physeterina.

3. Physeter. Head large, elongate, rather depressed in front.

4. Kogia. Head moderate, blunt and high in front. Skull short and broad. The septum that divides the crown of the skull very sinuous, folded so as to form a funnel-shaped concavity.

5. Euphysetes. Head moderate, blunt and high in front. Skull short and broad. The septum that divides the crown of the skull simple, longitudinal, only slightly curved."

No animal has ever been seen in recent times in which the alleged characters of frontal blow-hole and falciform dorsal have been found associated with the structural characters and size of *Physeter*, and as Dr. Gray himself remarks, "there is not a bone, nor even a fragment of a bone, nor any part that can be proved to have belonged to a specimen of this gigantic animal, to be seen in any museum in Europe." Commenting on this, Flower adds that "if the Linnæan genus *Physeter* is to be kept in abeyance until the discovery of Sibbald's *Balæna macrocephala tripinna* [the only basis for the so-called *Physeter tursio*], it is to be feared that it may ultimately disappear altogether from zoological literature." Heartily concurring in this view, and coinciding with the most judicious cetologists that the Sibbaldian animal was simply distinguished on account of a misapprehension as to its relations, and that it was, as Eschricht has observed,* an old cachalot with worn teeth, the name *Physeter* is retained for it as that proposed by the founder of zoological taxonomy. In this case the name *Physeterinæ* of course must be connected with the same form. The factitious genus

* Dr. Gray has, from some misunderstanding, remarked that "Eschricht seems to believe that Sibbald described a Killer or *Orca gladiator*, under the above name."

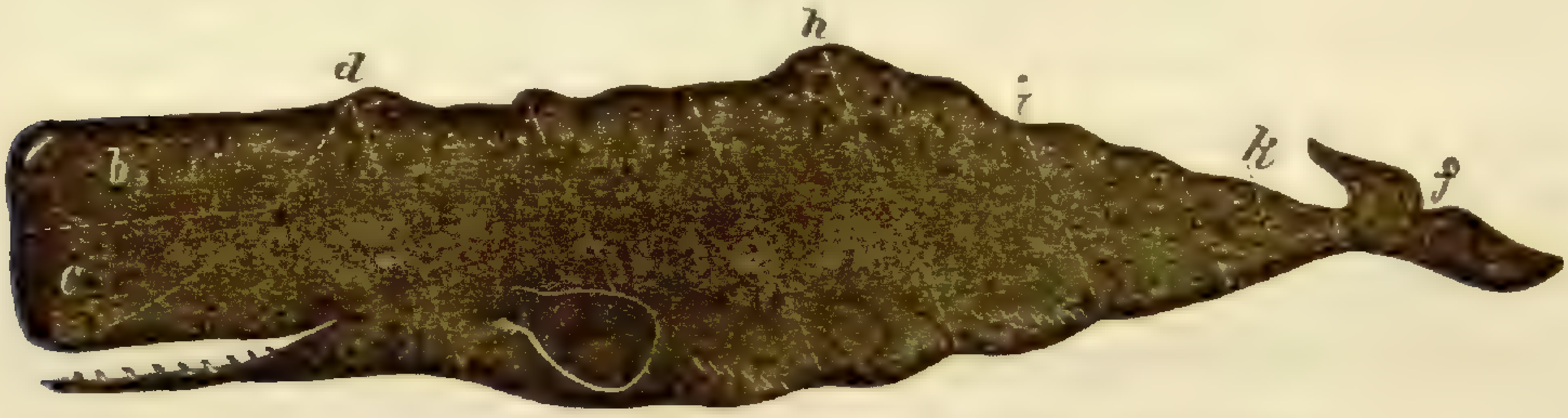
Physeter being eliminated, none but the small sperm-whales are left in the Grayan tribe *Physeterina*, and they form a natural group for which the name *Kogiinæ* has been above proposed; while the apparently most essential characters have been first attributed to it.

The genera *Catodon* and *Meganeuron*, distinguished, so far as known, solely by differences in the osseous development of the cervical vertebræ, may better be conjoined provisionally under the single generic name *Physeter*.

The diagnoses of *Kogia* and *Euphysetes* do not appear to be the expressions of actual differences.

7. *The Species of Physeterins.* The sperm whales, or Cachalots, according to Flower, "unlike the right-whales, are

Fig. 165.*



Physeter.

essentially inhabitants of the tropical and warmer parts of the temperate seas, and pass freely from one hemisphere into another." They have been observed in every sea, wandering northward in the Pacific to the Straits of Bering; in the Atlantic, straggling northward, at least as far as the coasts of Britain and the North Sea; and in the southern hemisphere, they have been found rounding the capes, and passing from one ocean to the other. "Between the North Atlantic and the Australian seas there is no barrier interposed to animals of such great powers of locomotion."

Fig. 166.†

*Fig. 165. Outline of the Cachalot, copied from Beale's "Natural History of the Sperm-whale," 1839, p. 23; *b*, the situation of the case; *c*, the junk; *d*, the bunch of the neck; *h*, the hump; *i*, the ridge; *k*, the small; *f*, the tail or flukes. Between the oblique dotted lines are the spiral strips, or blanket pieces; the area.

†Fig. 166. Head seen from the front; the lines forming the square are intended to represent the flat anterior part of the head.

As may be supposed, animals from places so widely distant have furnished the bases for different specific names, and after various fluctuations of opinion, in the last general com pleted work on the cetaceans—that by Dr. Gray already referred to—three authenticated and four doubtful species of true Physeterinæ are admitted, exclusive of the nominal *Physeter tursio.* The three considered established by him are *Catodon macrocephalus*, *Catodon australis*, and *Meganeuron Krefftii;* the four "species wanting further confirmation" are the Pacific sperm-whale (*Catodon Colneti* Gray), the South African sperm-whale (*Catodon macrocephalus* A. Smith), the Indian sperm-whale (*Catodon macrocephalus* Blyth), and the South Sea sperm-whale (*Physeter polycyphus* Quoy and Gaimard).

Professor Flower, after an elaborate comparison of skeletons of *Physeter* from the British waters and from the Tasmanian seas (the home of *P. australis*), arrived at the conclusion that the apparent differences of *P. australis*, compared with *P. macrocephalus*, were the characters of immaturity or the result of error in the identification of parts, and "putting aside these distinctive characters as valueless, there is not one other presenting any approach to a specific distinction pointed out throughout the whole memoir by Wall," and he himself has been unable to find any specific differences between the Northern Atlantic and Southern Pacific forms; he, however, is careful to remark that he does not "deny the possibility of their being specifically distinct," and very appropriately adds that "similarity of osteological characters does not prove unity of species." But until such can be defined, specific names would only mislead.

As to the "species wanting farther confirmation," it is sufficient that Dr. Gray ranks them in that category.

One other name only needs notice, the *Meganeuron Krefftii* Gray, founded on cervical vertebræ; the atlas certainly differs considerably from those of the *Physeter macrocephalus* hitherto made known. Mr. Krefft, however, who

transmitted them to Dr. Gray, finally regarded the "mass of vertebræ as belonging to *Catodon australis*." Until the acquirement of further data, the relations of the form will be doubtful.

8. *The Species of Kogiins.* Representatives of the subfamily have been obtained at the Cape of Good Hope, near Sidney (Australia), and from the coast of the Madras Presidency, and respectively attributed to four species. To the localities already distinguished, we may now add Lower California, from which the lower jaw of a specimen, as well as a figure and notice of the animal, have recently been forwarded by Colonel Grayson. It would therefore appear probable that the group is quite generally distributed in the

Fig. 167.

Kogia Floweri, adapted from a colored figure by Col. Grayson.

Pacific Ocean, and probably in the South Atlantic. The four forms previously distinguished as species have been referred by Dr. Gray, as already indicated, to two genera, *Kogia* and *Euphysetes;* the latter name having been restricted to the form on which it was primitively based, while the three others have been referred to *Kogia*. As above remarked, the pertinence of the new diagnosis of *Euphysetes* to its type is not apparent, and is at variance with the original description as well as figure of the species. Of the species mentioned, the Indian form is by far the best known, thanks to Sir Walter Elliot, the collector, and Professor Owen, the describer; two Australian forms have been specifically distinguished by Mr. Krefft, after an examination of the skeletons of both; the species of the Cape of Good Hope is only known from a skull, and the Californian species

only from the lower jaw and the accompanying figure; but those combined will be sufficient to readily distinguish the last species from its congeners, although we must await with impatience the collection of better material, and we may be allowed to hope that this article may incite our Californian friends to seek for and procure specimens.

Our present knowledge of the species of this sub-family seems to indicate that there are two well-marked divisions, one of which is represented by the species (*Physeter breviceps* Bl.), on which the genus *Kogia* was originally based by Dr. Gray, and to which the *Euphysetes Grayi* Wall, the *Euphysetes Macleayi* Krefft, and the Mazatlan individual also belong; and the other division is represented by the *Euphysetes simus* Owen. These are very decidedly distinguished by the difference in the form of the lower jaw, and the form as well as development of the teeth.

In all the typical Kogiæ, the lower jaw, for each ramus, has a more or less truncated oar-shaped posterior margin, and from its upper and lower angles, the respective margins converge, describing nearly straight or little convex outlines, to the alveolar area, the lower margin ascending upwards to the symphysis, where the rami are parallel or nearly so, and which there project downwards into a longitudinally convex carina. There are from thirteen to fifteen teeth in each ramus; they are very long, much curved, and acutely pointed.

In *Euphysetes simus* "each ramus has a convex, almost semicircular posterior margin, curving upward and backward from below where the angle normally exists in other mammals, and then forward to the seat of the coronoid process [etc.]. In the alveolar groove are partially excavated sockets for nine teeth [etc.]; the teeth are small, straight, conical, obtuse, not exceeding eight lines in length, of which the cylindrical base has a diameter of two lines, that of the crown a diameter of one and one-half lines, with a length of two and one-half lines, diminishing to a sub-recurved apex"

(Owen, l. c., p. 41). A pair of teeth are also developed near the front of the upper jaw. With these mandibular and dental characters seem also to be coördinated a less developed dorsal fin, comparatively longer temporal fossæ, the deep fissure limiting the front part of the supraorbital ridge; the more deflected jugals, and the more rounded lateral ridges of the hinder portions of the maxillaries. As it is certain that a generic name will sooner or later be desired for the form so distinguished, it may be called on account of the symmetrically rounded lower jaw *Callignathus*. The known species are as follows:

1. KOGIA BREVICEPS Gray ex Blainv. Habitat, Cape of Good Hope.

2. KOGIA GRAYI Gray ex Wall. Habitat, Australia, near Sydney.

3. KOGIA MACLEAYI Gray ex Krefft. Habitat, Australia, near Sydney.

4. KOGIA FLOWERI Gill. The form is robust; the dorsal very low, "posterior to which is a sharp ridge as if belonging to the fin, extending towards the tail;" the color black or blackish above, whitish or yellowish-white below, and upwards and forwards, including the end of the snout.

The lower jaw at its symphysis below is very compressed, has concave sides, and its greatest depth is at about the posterior third of the symphysis; the dentigerous area extends backwards nearly to the anterior point of the deltoid sinus of the inner wall of the dental canal, and is much incurved: behind the area, the margin is nearly straight and horizontal.

The teeth are very long and slender, very much curved outwards and backwards, and acutely pointed; there are about fourteen or fifteen in number on each side.

The animal on whose jaw and portrait the species has been based, was obtained a short distance from Mazatlan, in 1868, and measured nine feet in length; its blubber yielded seventy-five pounds of oil. No details as to its mode of capture were sent by Colonel Grayson, but it was remarked that "it is said to be a strange fish in those waters."

5. CALLIGNATHUS SIMUS. Habitat, India, coast of Vigigapataw, Madras Presidency.

9. *On the Nomenclature of Kogia.* A few words concerning the nomenclature of the genus seem to be demanded.

Dr. J. E. Gray, perceiving certain discrepancies between the figure and descriptive notice by Blainville of a skull from the Cape of Good Hope, referred by the latter author to the genus *Physeter*, and named *P. breviceps*, conferred

upon it in 1846 the barbarous generic name *Kogia*, with the following diagnosis:

"Head moderate, broad, triangular. Lower jaw wide beneath, slender, united by a short symphysis in front. Jawbone * of the skull broad, triangular, as broad as long."

In 1854, Mr. W: S. Wall, † in a "History and Description of the Skeleton of a New Sperm-whale [etc.]", described in addition a new pygmy species, to which he gave the name *Euphysetes Grayi*, evidently inclining to the opinion that it would prove to be congeneric with *Kogia breviceps*, but on account of the inapplicability of Gray's generic diagnosis, refusing to identify it with that form; he "regretted that a barbarous and unmeaning name like *Kogia* should have been admitted into the nomenclature of so classical a group as the cetacea."

The name *Kogia* has also been repudiated, and *Euphysetes* adopted by Professor Owen, who has acknowledged the generic identity of the species on which they were respectively based; in reference to it, that profound naturalist has remarked that he has "that confidence in the common sense and good judgment of [his] fellow countrymen and labourers in philosophical zoology which leads [him] to anticipate a tacit burial and oblivion of the barbarous and undefined generic names with which the fair edifice begun by Linnæus has been defaced." ‡

Dr. Gray, defending his name, has observed that "Mr. MacLeay objects to the barbarous name of *Kogia*;" and the learned doctor of philosophy, with charming naïvete, adds: "I have been asked, what does *Euphysetes* mean? should it

* Lest this character might be inexplicable, it is proper to state the author meant the rostral portion of the skull.

† The work quoted has been lately attributed to Mr. W. S. MacLeay, but as Mr. Wall has assumed the responsibility of authorship with the evident consent of Mr. MacLeay, there seems to be no good reason for accepting *ex parte* evidence in the case, or even for inquiring into the relations of the parties with regard to the contribution of scientific knowledge and literary skill; in this opinion, I simply concur with Professor Flower.

‡ Owen, Mon. Brit. Foss. Cetacea Red Crag, No. 1, 1870, p. 27; (Ray Society).

not have been written *Euphycetes*, with a *c?*" The suggestion of Dr. Gray's questioner can scarcely fail to elicit a smile at the ignorance displayed in the question, or perhaps a laugh at the execrably complicated pun that may have been intended, and which appealed to evidently unappreciative ears. The name is a *literal* rendition of the Greek (*Ευ*, augmentative, and *Φυσητὴς*, blower), and, as explained by the framer, simply means "*a good or easy blower*."

Notwithstanding, however, the objections to the name *Kogia*, we adopt it, as Professor Flower has also done, because of its priority, while we recognize the justness of the criticisms upon it. But if we were to pursue the course recommended in repudiation of it, hosts of generally admitted generic names would have to be superseded, among which would be most of those of the author of the name in question. Linné himself furnished a precedent for the adoption of names other than those derived from the classical languages, although *he* admitted such with cautiousness and a due regard for sense and euphony. Analogous names, proposed though they may be without like reserve, must in the judgment of the great majority of systematists be retained, lasting monuments to the discredit of their authors, and an opprobrium to zoology.

EXPLANATION TO CUTS.

168. Skull of *Callignathus simus*, seen from the side.
169. " " " " " " above.
170. " " " " " " below.
171. " " " " longitudinally bisected.
172. Lower Jaw of *Kogia Floweri*; the dotted lines indicate the approximate form of the hinder portion of the ramus.
173. Skull of adult *Physeter macrocephalus*, seen from the side.
174. " " " " " " " above.
175. " " " " " " " below.
176. " " " " " longitudinally bisected, to show the relative size and the form of the cranial cavity.

bo, basioccipital; *eo*, exoccipital; *so*, supraöccipital; *p*, parietal?; *s*, squamosal; *f*, frontal; *pl*, palatine; *j*, jugal; *sh*, stylohyoid; *bh*, basihyoid; *th*, thyrohyoid.

NOTE.—All the figures of the ten illustrations of Cachalot (*Physeter macrocephalus*) are copied from Professor Flower's monograph "On the Osteology of the Cachalot or Sperm-whale (*Physeter macrocephalus*)," in Trans. Zool. Soc., London, Vol. vi, pp. 309–372, 1868, and those of *Callignathus simus*, from Professor Owen's memoir "On some Indian Cetacea collected by Walter Elliot, Esq.," in Trans. Zool. Soc., London, Vol. vi, pp. 87-116, 1866. The lower jaw of *Kogia Floweri* is from nature.

Fig. 172.

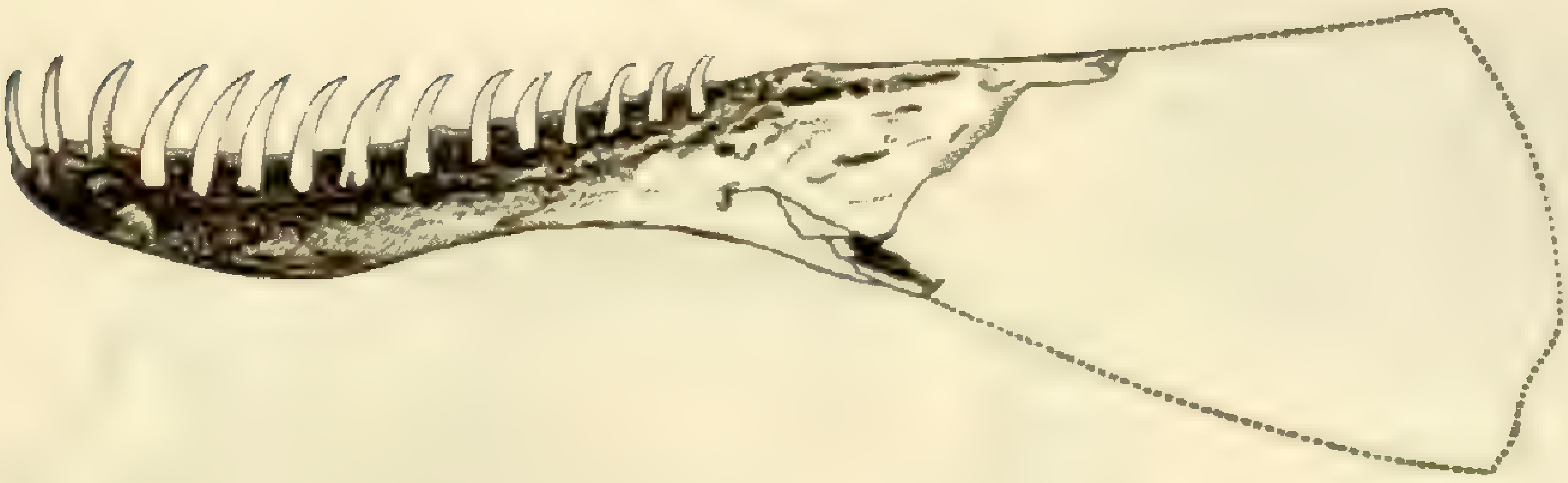


Fig. 169.

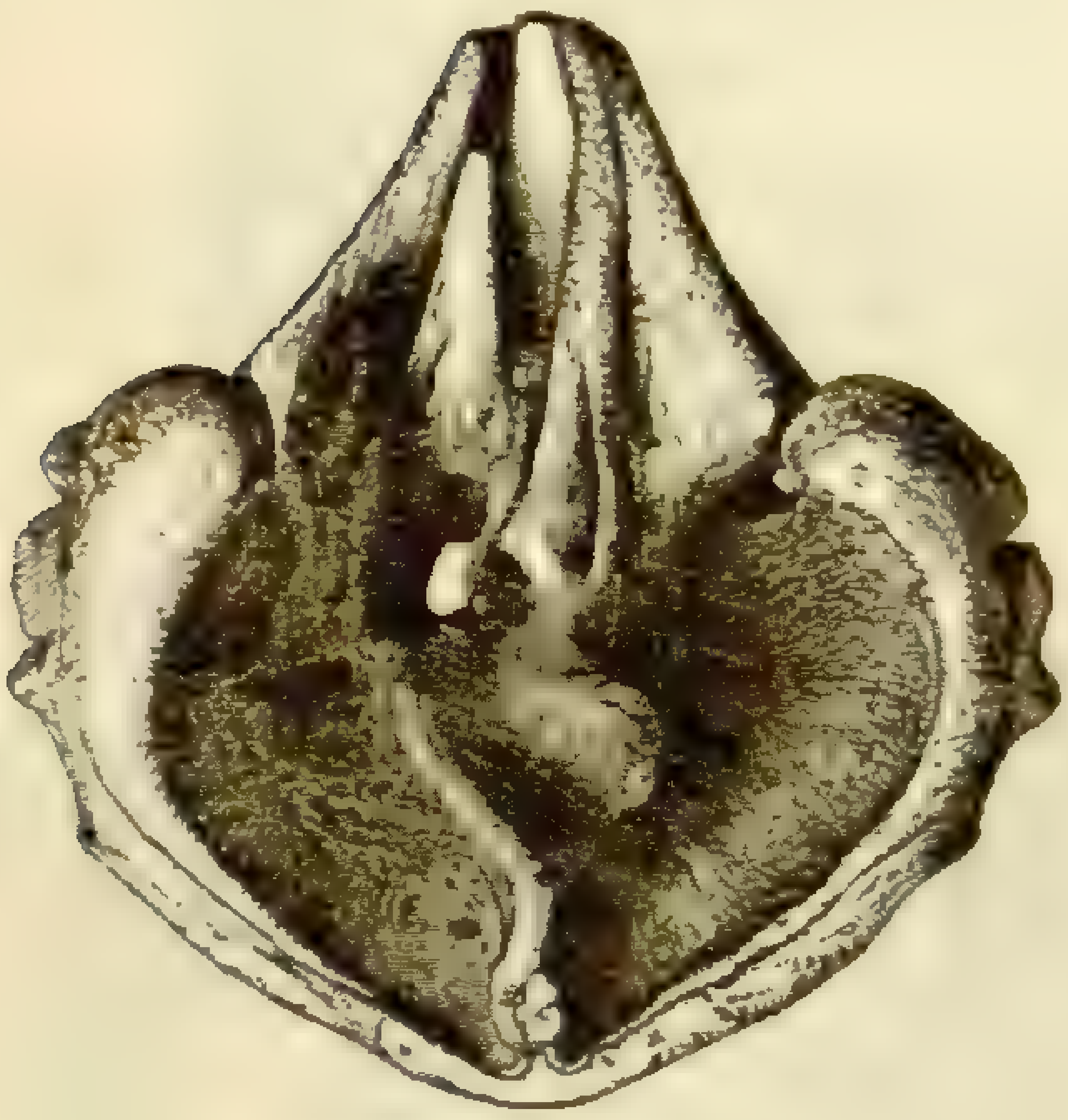


Fig. 171.

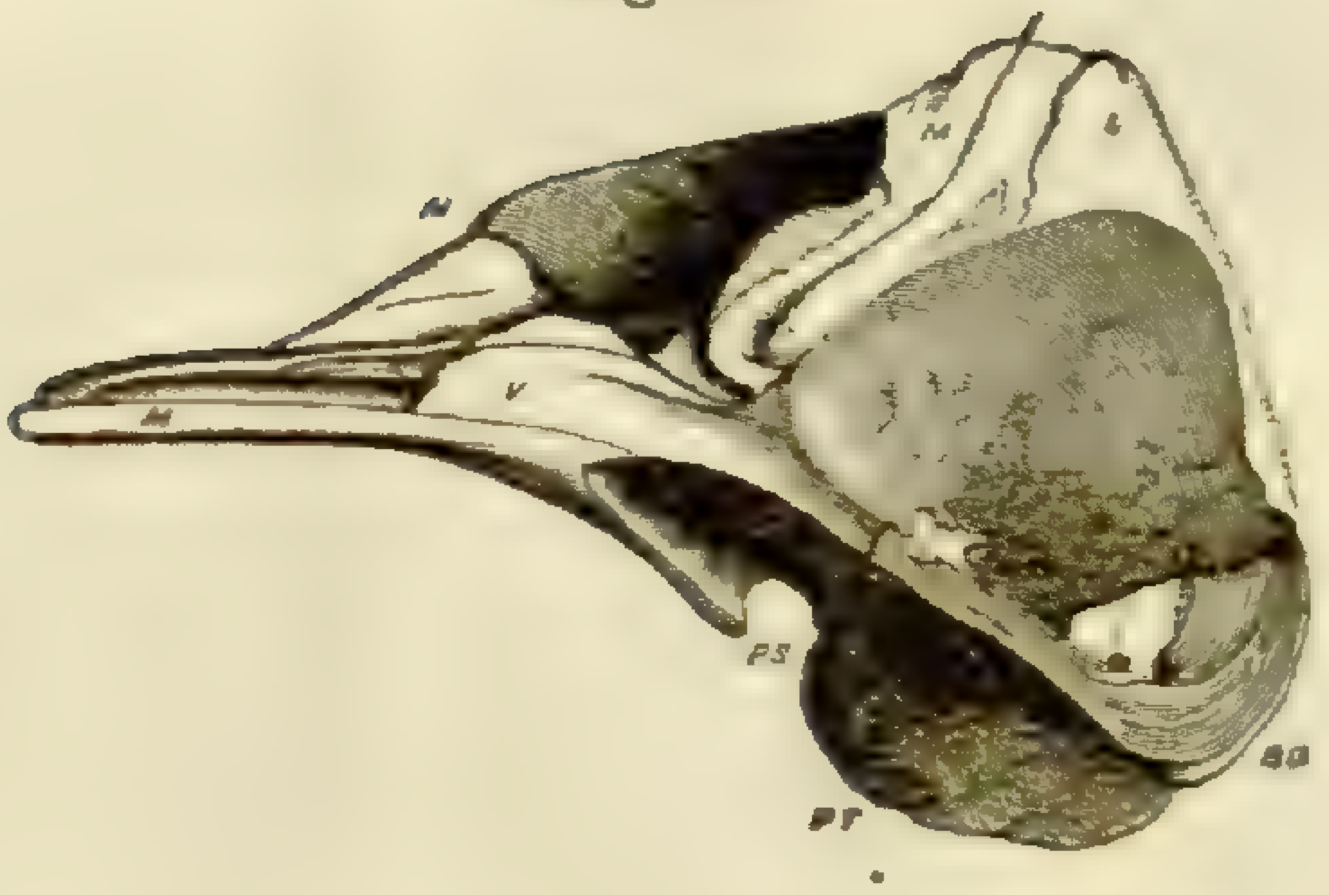


Fig. 170.

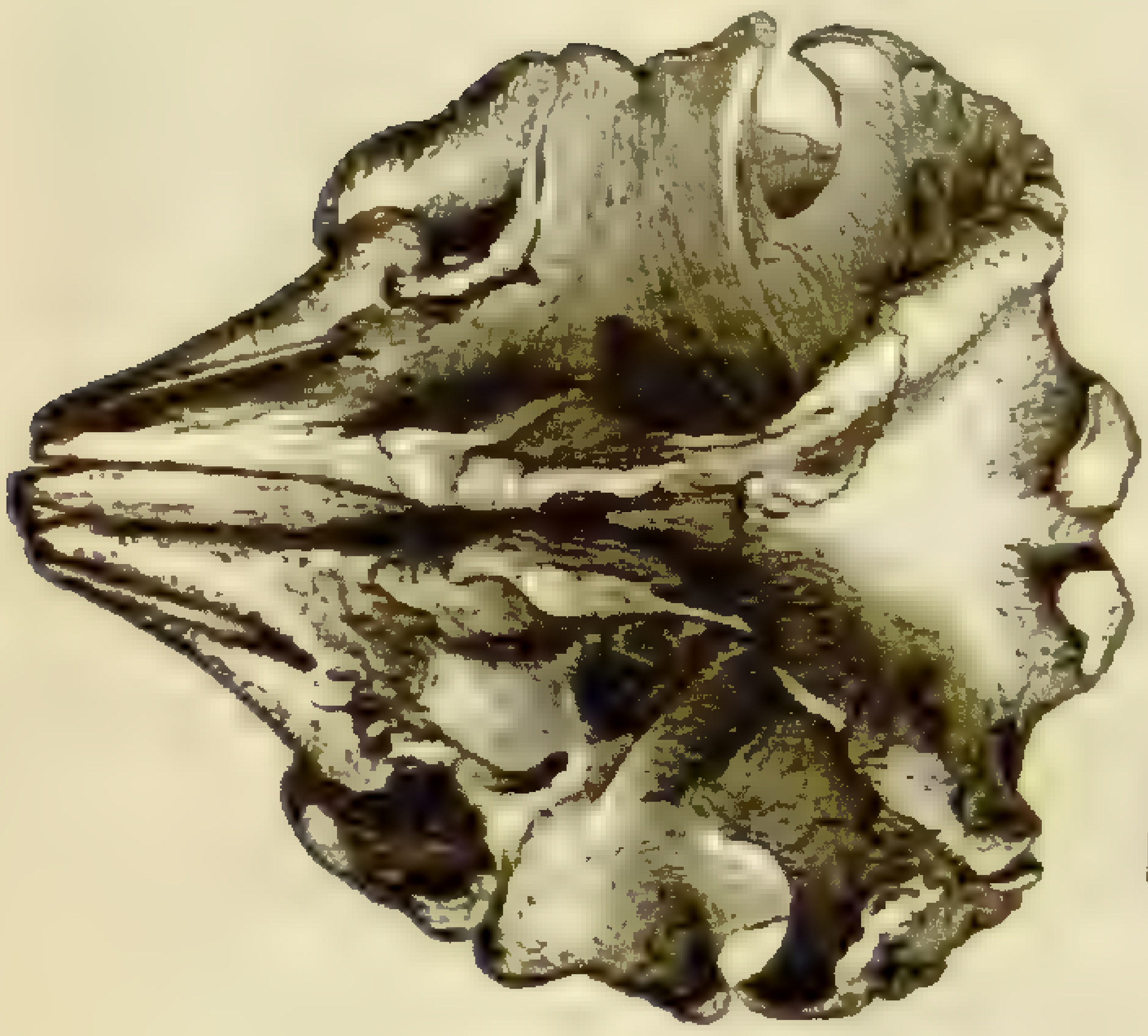


Fig. 168.

Fig. 174.

Fig. 173.

Fig. 176.

Fig. 175.

REVIEWS.

Deep Sea Explorations.—In the Report before us * are given the preliminary proceedings and equipment, the narrative of the three cruises performed during 1869, the general results so far as they relate to Physics and Chemistry, and, in an appendix, a summary of the observations upon, and analysis of, samples of sea water and deep sea bottom collected during the cruise. Passing over the first portion for the sake of brevity, (though there is much, especially in the description of the equipment, to interest all naturalists), we learn that the Porcupine, with Mr. Jeffreys and Mr. W. B. Carpenter on board, left Woolwich, May 18th, and after coaling at Galway, on the west coast of Ireland, cruised, dredging at intervals, to the southward and westward. The greatest depth reached was 808 fathoms and an essentially northern fauna was discovered throughout. Among the collections, were *Nucula pumila*, *Verticordia abyssicola*, "*Fusus*" n.sp. like "*F.*" *Sabinii*, *Phakellia ventilabrum*, *Gonoplax rhomboides*, *Ebalia* n.sp., *Ethusa* n.sp., *Geryon tridens* and many small crustaceans. The next dredgings were taken in a line eleven degrees of longitude due west from Galway, and reached a depth of 1230 fathoms. All the mollusca except *Aporrhais Serresianus* were northern (the temperature of the bottom being 37° 8′ Fahr.); several new species and two new genera of the family *Arcidæ* were found, as well as *Trochus minutissimus* Mighels (which has two conspicuous eyes), a species of *Ampelisca*, an eyed crustacean, and numerous gigantic foraminifera. A third trip, from Killebegs to the Rockall Bank was then made, and dredgings as deep as 1476 fathoms succeeded in obtaining an abundance of life. Among the species were an imperforate brachiopod with a septum in the lower valve, which Mr. Jeffreys calls *Atretia gnomon*, *Kelliella abyssicola* Sars, *Cumacea* n.sp., several small new crustaceans; *Pourtalesia*, probably *P. miranda*, A. Ag. and many fine foraminifera, including an *Orbitolites* of the size of a sixpence. The vessel reached Belfast at the end of her cruise on the 13th of July, 1869. The second cruise, under Prof. Wyville Thompson and Mr. Hunter, was undertaken for the purpose of getting a haul of the dredge in 2500 fathoms of water and thus affording a reasonable ground for belief that, if life existed at that depth, it could have no bathymetrical limits. In Lat. 47° 38′ north, and Lon. 12° 08′ W. Gr. a depth of 2435 fathoms was obtained, and a dredge weighing 225 lbs. was sent down with a heavy weight attached to the line five hundred fathoms from the dredge, in order to make it bite the bottom. This apparatus, attached to 3000 fathoms of line, was ten minutes in running out.

*Preliminary Report of the Scientific exploration of the Deep Sea in H. M. Surveying Vessel Porcupine, during the summer of 1869. Conducted by Dr. W. B. Carpenter, V.P.R.S., J. Gwyn Jeffreys, F.R.S., and Prof. Wyville Thompson, LL. D., F.R.S. (Proc. R. Soc. No. 121.)

When hauled in, the dredge contained 150 lbs. of pale gray ooze, containing 23 per cent. of silica, 61 per cent. of carbonate of lime, with some alumina, carbonate of magnesium, and oxide of iron. The animals brought up were, among others, *Dentalium* n.sp. (large), *Pecten fenestratus, Dacridium vitreum, Scrobicularia nitida, Neæra obesa, Anonyx Hölbollii* Kroyer, *Ampelisca æquicornis* Bruzel., *Munna* n.sp., several annelids; *Ophiocten Kroyeri* Lütken, *Echinocucumis typica*, Sars; a stalked crinoid allied to *Rhizocrinus; Salicornaria*, n.sp., two fragments of a hydroid Zoöphyte; numerous foraminifera, with a branching flexible rhizopod having a chitinous cortex studded with *Globigerina*, enclosing a sarcodic medulla of olive green hue; several small sponges belonging to a new group, etc., etc. Another subsequent haul brought up a *Pleurotoma* n.sp., *Dentalium* n.sp., and *Ophiocantha spinulosa*, besides others previously mentioned. Many of the animals were brilliantly phosphorescent and the eyes in species of all classes were well developed, showing that in these abysses light of some kind must exist. The temperature at the bottom in this case was 36° 5′ Fahr. against 65° 6′ Fahr. at the surface.

The third cruise in charge of Dr. W. B. Carpenter, Prof. Wyville Thompson and Mr. P. Herbert Carpenter, was devoted to the exploration of the *warm* and *cold* areas which had previously been shown to exist between the north of Scotland, the Hebrides, and the Faroe Islands. Space will not admit of even a condensed exhibit of the valuable results obtained on this cruise.

The most important and valuable of the results of these dredgings, due to the great liberality of the British Government, may be succinctly stated as follows.

1. It has been practically proved that there is no limit to the existence of animal life as far as depth is concerned, and that the difference in the specific gravity of the water at the surface and at 2500 fathoms is less than that between salt and fresh water.

2. That there is a constant interchange between the carbonic acid gas from the bottom and the oxygen at the surface, by which the animals at great depths are provided with means of respiration.

3. An abundant supply of dilute protoplasm in the water serves as food for the protozoic inhabitants of the deep sea, upon which latter the higher animals subsist.

4. A glacial *submarine* climate may exist over any area, without reference to the *terrestrial* climate of that area.

5. Cold and warm areas may exist in close juxtaposition, at great depths, and at the same time present quite distinct faunal characters.

6. The bottom, as analyzed by David Forbes, F.R.S., differs essentially in composition from the chalk rock (cretaceous) of England, and no evidence whatever has accumulated to sustain the hypothesis of Dr. Carpenter that the Cretaceous period is at present progressing in the Atlantic sea bed; indeed, that gentleman, in a late letter in "Nature" has practically abandoned this theory.

7. *Temperature* is the great agent which determines the distribution of submarine animals; a view previously maintained by many eminent naturalists and now permanently established by these, and other dredgings in the Atlantic, and by the researches of American naturalists in the North Pacific.

It is to be regretted that the views of Mr. Jeffreys in regard to the specific and generic limits of animals, differ so widely from those of the majority of modern naturalists. In the present report he unites animals belonging to different genera under the same specific name; e. g., *Waldheimia septigera* and *Terebratella septata*, and those who have had occasion to critically examine his British Conchology, find in it many similar cases. Such determinations, of course, will tend to invalidate any conclusions which may be drawn from his report, and will undoubtedly throw a certain amount of confusion upon the whole subject. — W. H. D.

THE CLASSIFICATION OF WATER BIRDS.* — Although from the title of this paper one might reasonably expect to find the classification of the commonly so-called water birds in general treated of, the writer restricts himself in this able essay to the consideration of the "swimmers proper, as distinguished from aquatic, or even natatorial *Grallæ*." The series of special papers on several of the principal groups of the swimming birds which Dr. Coues has published during the last few years† indicates sufficiently his familiarity with the subject he treats; and the scientific student will find himself warranted in the natural anticipation of finding the essay in question full of important and, in general, well considered data.

Dr. Coues sets out with the assumption that it is demonstrable that the *Natatores* "are one of three primary divisions of birds, at least of carinate birds," which he regards, practically, at least, as subclasses. To prove that the *Natatores* are such a division, and to define the "orders and families" of this subclass, he states to be the object of his paper.‡ After alluding to the fact that a singular unanimity has prevailed in regard to the definition of the group of *Natatores*, and that in the main similar subdivisions have been recognized, though by different authors differently collocated and their rank differently estimated, he proceeds briefly to a consideration of four of the leading modern systems of ornithological classification. These are, to quote his own words, "(1) a

*On the Classification of Water Birds. By Elliott Coues, A. M., M. D., Ph. D., etc. Proc. Phil. Acad. Nat. Sci., 1869, Vol. 1, pp. 193-218. December, 1869.

† (1.) Synopsis of the North American forms of *Colymbidæ* and *Podicipidæ*. Proc. Phil. Acad. Nat. Sci., 1862, pp. 226-233, April, 1862. (2.) Revision of the Gulls of North America. Ibid., pp. 291-312, June, 1862. (3.) A Review of the Terns of North America. Ibid., pp. 535-559, Dec. 1862. (4.) A Critical Review of the subfamily Lestridinæ. Ibid., 1863, pp. 121-138, May 1863. (5.) A Critical Review of the family *Procellaridæ*. Ibid., 1864, pp. 72-91, March, 1864; pp. 116-144, April, 1864; 1866, pp. 25-33, March, 1866; pp. 134-197, May, 1866. (6.) The Osteology of Colymbus torquatus; with notes on its Myology, Mem. Bost. Soc. Nat. Hist., I, pp. 131-172, April, 1866. (7.) A Monograph of the Alcidæ. Proc. Phil. Acad. Nat. Sci., January, 1868.

‡ In a foot-note (p. 209) he states subsequently that he uses the term "subclass" in a conventional sense only.

dichotomous arrangement in two 'parallel series,' based upon one physiological character, — *Bonaparte*; (2) a trichotomous, founded upon very general considerations, — *Nitzsch*, and after him *Lilljeborg*; (3) quinary, a modification of the second, by dividing two of the three divisions into two each, and with minor changes, — *Vigors*, and many others; (4) another trichotomous, but from a totally different standpoint — recognition of birds as modified reptiles — and carried out with special reference to one anatomical character, afforded by certain cranial bones, — *Huxley*." Each of these systems is reviewed at some length, their general features succinctly presented, and many of their deficiencies pointed out.

In his remarks upon the Bonapartean system, Dr. Coues objects to the comparison of the two groups of birds termed *Altrices* and *Præcoces* to the primary divisions of mammalia, "the *Placentalia* and *Monotremata*"; an objection which appears to be well founded; for in the one case there are important, constant structural differences, whereas in the other no such differences exist. "If helplessness at birth compared with precocity," says Dr. Coues, "means, among birds, 'high' as opposed to 'low' in the scale, then either the reverse is the case with mammals, or else we must compare altricial *Incessores* with Marsupials, and præcocial *Natatores* with the higher orders: a dilemma either horn of which is sufficiently difficult." With the radical differences that exist between the placental and implacental mammalia, and the almost entire homogeneousness of the whole bird type, it is evident that no primary divisions of the latter have yet been discovered that are coördinate with the placental and implacental divisions of the latter. Hence, doubtless, as Dr. Coues partially suggests, birds, in regard to the condition of the young at birth, should be compared with the *Placentalia* alone. The præcocial birds would then be comparable with the præcocial Placentals, (as the *Herbivores*,) and the altricial birds with the altricial or higher Placentals. The vast difference in the modes of generation between birds and mammals, and between the two subclasses of mammals, renders the resemblance, as primary groups, of *Altrices* and *Præcoces* to the Placentals and Marsupials one rather of remote analogy than of homology or true parallelism. So widely different, in fact, are the ornithic and mammalian modes of execution of the vertebrate plan, especially as regards the mode of reproduction, that it is difficult to conceive of the possibility of a division of birds into two groups which would be strictly comparable with the subclasses of mammals. It is nevertheless true that in the two great groups of birds first recognized by Oken — the *Altrices* and *Præcoces* — but afterwards so thoroughly elaborated by Bonaparte that the system, as all will admit, appropriately bears his name, there is something that forcibly recalls the two subclasses of mammals. This division, in the present writer's opinion, trenchantly separates birds into two highly natural, primary series, with, to a great extent, parallel or representative groups in each, and so distinct that no removal of any of the groups of the one series to the other can be made without bringing illy-asso-

ciated groups into juxtaposition, although no constant structural difference has yet been discovered by which to separate them.

The partially natural basis on which the system of Nitzsch is based is clearly recognized by Dr. Coues, although the data on which it was founded have thus far been but very imperfectly presented.

In regard to the quinary system of Vigors, though theoretically wrong in its assumptions, especially as developed by some of Vigors's followers, Dr. Coues justly finds (as the present writer has been long of the opinion there existed) many facts that to a certain extent favor this arrangement in regard to many of its details. The remarkable vitality of the system, and its strong hold upon public opinion, as Dr. Coues observes, is evidence that it has some foundation in nature, in consequence of which it was able for a long period to hold its ground despite the numerous technical objections that have been urged against it, and the invectives and sneers of its opponents, as well as the far more injurious indiscretions of its friends. As Dr. Coues in this connection remarks, it was a great stride onward when the idea of a "lineal" classification was abandoned; and it was doubtless the advantages of the "circulatory" system of grouping, and the recognition of similar modifications of the members of diverse groups that gave to the Vigorean system some of its recognized advantages. Dr. Coues, however, goes further: "A system," he says, "that disposes objects in circumscribed planes is a great advantage over a lineal arrangement, but it stops half-way to the goal. The third dimension is needed; to length and breadth must be added thickness; the circle must become a sphere. . . . . We cannot predicate affinity or analogy only to the right or left, — the top or bottom, — but must take it that all groups, near or remote, may approach, touch, or fuse with each other, along the axis of either of the three possible diameters" (p. 197). The idea here embodied — that of the possibility of the affinities of groups lying not in a single direction only, but in several or in any direction (though not necessarily implying generic relationship) — is one that has doubtless impressed the majority of naturalists, and which has given rise, in the various efforts made for its expression, to the numerous and often fancifully inosculating systems of different authors. The metaphysical form in which Dr. Coues expresses this idea imparts to it, doubtless, to many minds, a somewhat objectionable character.

In reviewing Professor Huxley's classification, Dr. Coues terms it "an attempt" — as a slight examination of it is sufficient to show — "to classify birds with reference to a single set of characters — the modification of certain cranial bones." His criticism of it, though severe, is discriminating and appreciative, and will receive the sanction of probably a large proportion of ornithologists. A summary of his views may thus be given in his own words: "Prof. Huxley has laid ornithologists under two-fold obligations: First, he has pointed out in elaborate detail a certain character, the value of which was not only unknown, but also unsuspected before; and has shown how perfectly it marks groups of a

certain grade. Second, he has demonstrated once more — and it is to be hoped for the last time — the futility of attempting to found such fundamental divisions [" orders," etc.] upon any one single character. . . . As the sole basis for a system of ornithological classification, the scheme will probably remain in critical abeyance only until the time when its brilliancy shall have been forgotten, and its unsoundness alone remembered."

Professor Lilljeborg's system is justly referred to as "the most 'catholic' system that has ever been proposed;" since cognizance is taken by its author of the works of most of those specialists who have investigated certain sets of characters, on which, however, they improperly based systems of classifications. Lilljeborg's system not only meets, in general, the approval of Dr. Coues, as of numerous other ornithologists, but it is essentially followed by him in his classification of the *Natatores*, although he adopts an opposite order of arrangement of the several groups. His scheme is hence almost the same as that of the "Arrangement of Families of Birds" published in 1866 by the Smithsonian Institution,* which was only a slight modification of Professor Lilljeborg's system. Dr. Coues regards the division of the *Natatores* by Lilljeborg into two groups — *Simplicirostres* and *Lamellirostres* — intermediate in rank between the subclass and the orders, as not only a superfluous intercalation, but as an unnatural division, from the inequivalency of the two groups; this discrepancy constituting the chief difference between the systems of Coues and Lilljeborg.

In discussing the relations of the *Natatores* to the *Grallatores*, the character and affinities of two "ambiguous forms" are incidentally adverted to. These are the *Phœnicopteridæ* and the *Haliornithidæ*, the latter of which is regarded as fulicarious in its affinities, and the former as belonging to the grallatorial *Cursores*. Notwithstanding the heron-like form of the Flamingoes, almost their whole structure is so well known to be anserine — with which their prœcocial habits accord — that it is a matter of surprise that Dr. Coues should follow Lilljeborg and others in referring them to the *Cursores;* almost their sole point of divergence from the *Anatidæ* consisting in their elongated grallatorial form, they being in fact merely long-legged ducks.

Dr. Coues's classification of the *Natatores* may be tabulated as follows:

* Smithsonian Miscellaneous Contributions, Vol. viii, p. 8, June, 1866.

Subclass.	Orders.	Families.	Subfamilies.	
Natatores.	I. Pygopodes.	Spheniscidæ (Penguins.)		
		Alcidæ.	*Alcinæ* (Auks.) *Phaleridinæ* (Crested Auks.) *Uriinæ* (Guillemots.)	Altricial.
		Colymbidæ (Loons.)		
		Podicipidæ (Grebes)	*Podilymbinæ* (Grebes.) *Podicipinæ* (Grebes.)	Precocial.
	II. Longipennes.	Procellariidæ.	*Diomedeinæ* (Albatrosses.) *Procellarinæ* (Petrels.) *Halodrominæ.*	Altricial.
		Laridæ.	*Lestridinæ* (Jaëgers.) *Larinæ* (Gulls.) *Sterninæ* (Terns.) *Rhynchopinæ* (Skimmers.)	
	III. Steganopodes.	Sulidæ (Gannets.) Pelecanidæ (Pelecans.) Phalacrocoracidæ (Cormorants.) Plotidæ (Darters.) Tachypetidæ (Frigate Birds.) Phaethontidæ (Tropic Birds.)	Altricial.	
	IV. Lamellirostres.	Anatidæ.	*Anserinæ* (Geese.) *Anatinæ* (River Ducks.) *Fuligulinæ*, *Erismaturinæ* (Sea Ducks.) *Merginæ* (Mergansers.)	Precocial.

While the above system, as already stated, differs in no very essential points from others previously proposed, but is rather a corroboration of the one before most approved, we find collocated in Dr. Coues's essay many facts not previously brought together. Great value is also given to the paper by the comprehensive and well elaborated diagnoses of the groups which it contains.

As indicated in the foregoing remarks, we are not prepared to accept Dr. Coues's classification in full, notwithstanding the evident thorough-

ness with which he has gone over the ground. To state the reasons which lead us to a different opinion would require far more space than can be devoted to the subject here. We may add, however, that the separation of birds into *Altrices* and *Præcoces*, though based chiefly upon physiological distinctions, is a classification that appears to separate the birds into two natural, primary groups, — a division wholly ignored however by Lilljeborg and rejected by Dr. Coues. In regard to the character which lies at the foundation of this division, the latter author himself admits that "as collateral testimony in the formation of orders and location of families, it has much weight;" and that "certain doubtful cases will probably be decided by reference to it." As he says further, "It draws a sharp, if here and there a broken [?], line between *Gallinæ* and *Columbæ*. It separates, with precision, herons and their allies from other *Grallæ*. *It goes some way in distinguishing lamellirostral from other Natatores;* and other instances of its application might be cited." The exception doubtless referred to in the italicized portion of the above extract occurs in the *Pygopodes*, which is an (artificial?) association of altricial and præcocial types. On this basis the "order" *Pygopodes* would be divided, the altricial *Alcidæ* and *Spheniscidæ* being associated with the *Altrices* as the lowest members of that series, and the *Colymbidæ* and *Podicipidæ* with the *Præcoces*, as its lowest representatives. *Longipennes* would stand first or highest in the altricial series of the *Natatores*, followed by the *Steganopodes* and the altricial *Pygopodes*. The *Lamellirostres* would head the præcocial or lower series, followed by the *Colymbidæ* and *Podicipidæ*.

Finally, a word in regard to one or two other systems. Birds, more than any other class of vertebrates, being fitted to live more or less exclusively in either the air, the water, or on the land, the duties of reproduction alone rendering the latter indispensable to some of them, different modes and degrees of locomotion, with corresponding differentiations of the locomotive organs, are required to adapt them to their several modes of life. But facts go to prove that such modifications have not necessarily a high taxonomic value. Birds of great powers of flight, for example, all have a more or less strongly keeled sternum. The greater the power of flight, the larger not only do we find the wing and its motor muscles, but also the processes for their attachment and support, and hence necessarily in these we get a great development of the sternal crest; and, on the other hand, with diminished powers of flight, the converse of all this, till gradually the wings become functionally abortive, and the sternum a smooth buckler. An exclusively walking or swimming bird (a non-flying bird), with a largely developed sternal crest would be an anomaly in nature; and a flying bird, especially one preëminently strong of wing, without a highly produced sternal crest, would be apparently an impossibility. Hence the propriety of founding subclasses principally upon the presence or absence of such a sternal character — as it is well known has been done — seems at least highly questionable. Again,

webbed feet, which usually accompany a swimming or aquatic mode of life have been erroneously accorded a similar importance in classification. Yet the altricial *Natatores*, the *Laridæ* especially, and preëminently the *Lestridinæ*, have the most positive affinities with the *Raptores*, of which they are really the aquatic or natatorial form. However valuable such features may be in determining the limits and relations of families, and of groups next above families, modifications of the locomotive organs can hardly be considered as a proper basis for subclass or even ordinal divisions.—J. A. A.

THORELL'S EUROPEAN SPIDERS.* — The character and extent of this work, which is invaluable to students of spiders even in this country, can not be better stated than in the words of the author (pages 18 and 19):

"I have first made up a systematical list or review of the suborders, families, subfamilies and genera of European spiders recognized by me. Each generic name is accompanied by the name of the author who first published it, and the year when this took place, moreover by its etymological derivation, its synonyms and the name of the species that typifies the genus; and lastly are subjoined such synonymical and critical remarks as I have thought appropriate. In almost all the genera which I have had the opportunity of examining, I have subjoined a short description of the form and armature of the tarsal and palpal *claws*, which organs have not yet attracted all the notice they appear to deserve. Under the head of each family I have introduced a short account of the characteristics of the subfamilies and genera it comprises. These characteristics I have endeavored as far as possible to derive from the number and position of the eyes and the form of the organs of the mouth, partly because such distinctive features are easily verified, partly because they are most generally (often too exclusively) used, at least in determining the limits of the generic groups. But I have also endeavored to make use of the different forms and numbers of the spinners, of differences in the conformation of the cephalothorax and abdomen, in the relative lengths and armature of the legs, the number of claws on the tarsi, etc. Genera which rest exclusively on such characteristics as belong *only to one sex* leaving the other undetermined, I have not adopted, but consider that they ought to be unreservedly rejected. I ought to call especial attention to the circumstance, that exotic forms have not been taken into consideration in the formation of these schematic reviews, which accordingly can be used as a clew in classifying such only as belong to the *European* fauna. The characteristics of the *sub-orders*, as they cannot be expressed in a few words, and indeed may be considered as generally known, I have not thought it necessary to repeat, but refer for them to e. g. Latreille's, Sundevall's, Westring's and Ohlert's works.

In the catalogue of arachnological literature, with which I have opened this treatise, I have included all the works known to me on *now existing* European spiders, of a *descriptive*, *systematical* and *zoo-geographical* character, with the exception of such writings as belong to the præ-Linnean period, of which only a small number of works, referred to in the following pages, have been admitted."

The catalogue contains the titles of nearly four hundred works, arranged alphabetically, according to their authors.

After a discussion of the principles of zoological nomenclature and a statement of those which he has followed, the author proceeds to review the three principal works on European spiders: Westring's "Araneæ Suecicæ," Blackwall's "History of the Spiders of Great Britain and Ireland," and Eugene Simon's "Histoire Naturelle des Araignees," and to compare the spider fauna of Scandinavia with that of Great Britain and Ireland.

In regard to the classification of the spiders, he says:

* On European Spiders. By T. Thorell. Part 1. Upsala, 1869-70. 4to. pp. 242.

"Whether we endeavor to arrange the families and genera of spiders in a continuous series, from that group which is looked upon as the most perfect down to the lowest, or vice-versa, or whether we arrange them according to some other principle, we are soon met by the same difficulties, which present themselves, whenever we endeavor to arrange in such a manner any class or order whatever of the productions of nature. As regards the larger groups of spiders, the suborders and the families, the reasons for the order of arrangement we have chosen will, we hope, easily be seen if one casts one's eye on the accompanying diagram, which gives a view of the connection founded on real *affinity*, which the families of the spiders adopted by us, according to our opinion, have to each other."

Fig. 177.

Phrynoidæ.

Opiliones.

I. Orbitelariæ.
  1. Epeiroidæ.
II. Retitelariæ.
  2. Theridioidæ.
  3. Scytodoidæ.
  4. Enyoidæ.
III. Tubitelariæ.
  5. Urocteoidæ.
  6. Omanoidæ.
  7. Hersilionidæ.
  8. Agalenoidæ.
  9. Drassoidæ.
  10. Dysderoidæ.
  11. Filostatoidæ.
IV. Territelariæ.
  12. Theraphosoidæ.
  13. Liphistioidæ.
  14. Catadysoidæ.
V. Laterigradæ.
  15. Thomisoidæ.
VI. Citigradæ.
  16. Lycosoidæ.
  17. Oxyopoidæ.
VII. Saltigradæ.
  18. Myrmecionidæ.
  19. Otiothopoidæ.
  20. Dinopoidæ.
  21. Eresoidæ.
  22. Attoidæ.

In a note, the author expresses his belief with Darwin, that "propinquity of descent is the hidden connection which our classifications attempt to find and express.

The work closes with a list of the genera of fossil spiders found in Europe, compared with living genera.—J. H. E.

GEOGRAPHY AND ARCHÆOLOGY OF PERU.* — While in England recently, Mr. Squier was induced by his friends to reprint in pamphlet form the paper which he read before the American Geographical Society in February last. We gave an abstract of that portion of the lecture which related to the Archæology of Peru in the NATURALIST for September; but the present pamphlet contains much interesting and important information relating to the geography of the great Titicaca basin to which we did not allude in our former notice, and will well repay reading by all interested in this great centre of a prehistoric nation.

NATURAL HISTORY MISCELLANY.

ZOOLOGY.

MORPHOLOGY AND ANCESTRY OF THE KING CRABS. — In a communication to the Boston Society of Natural History, Oct. 17, 1870, Dr. A. S. Packard, Jr. stated that a study of the embryology of Limulus, as well as its anatomy, led him to consider, as several authors had done, from Savigny and Van der Hoeven down to the present time, the anterior division of the body as a cephalothorax, the posterior division being the abdomen. Latreille, Milne-Edwards, and more recently Mr. Henry Woodward, † the distinguished palæontologist, have regarded the anterior division of the body as the head, and the posterior division as embracing the thorax and abdomen, the last three segments in Mr. Woodward's opinion, including the telson, representing the abdomen. Against this view he thought could be brought the embryological facts already stated at the meeting of the American Association for the Advancement of Science at Troy. He there stated that the germ first started as a Nauplius and that just previous to moulting a Nauplius-skin in the egg, the abdomen was differentiated from the cephalothorax. In this latter region (composed of six segments) are contained not only the eyes, simple and compound, but all the ambulatory appendages, which surround the mouth and are true maxillipeds, no antennæ or thoracic appendages being developed. This region contains the stomach and a considerable portion of the intestine, and the liver, which opens into the intestine near the middle of the cephalothorax, sending but a single pair of biliary tubes into the abdomen. The anterior half of the dorsal vessel, with two pairs of arteries and two pairs of valvular openings, is situated in the cephalothorax.

* Observations on the Geography and Archæology of Peru. By E. G. Squier, M.A., F.S.A. etc. 8vo. pamph. London. Trubner & Co., 1870. (Price 25 cents. Address Naturalists' Agency.)

† On some Points in the Structure of the Xiphosura. Quarterly Journal of the Geological Society of London for Feb. 1867.

Lastly, the genital openings in both sexes are situated on the first pair of abdominal lamellate appendages, the testes and ovaries lying wholly in the cephalothorax; the ovaries, when distended with eggs, filling up the front of the cephalothoracic shield.

The abdomen consists of nine segments, the long spine-like telson forming the ninth, as seen plainly in the embryo. The abdominal cavity is small, the abdomen being very thin, and mainly filled with the muscles attached to the lamellate feet.

There are, then, in Limulus, no thoracic feet, comparable with those of the Decapods and the Tetradecapods, and the thoracic region (as much of it as exists), is merged with the head, in fact never becoming differentiated from the head proper. Thus we have in Limulus a crustacean with the body divided into two regions; a cephalothorax (the thorax being potential, viewed externally, with no appendages or segments to indicate its existence) and a nine-jointed abdomen.

This disposition of the body-segments is paralleled by the zoëa, or young, of the Decapods. In the freshly hatched zoëa the body is divided into two regions; the cephalothorax, with no trace at first of thoracic segments, or thoracic appendages, (the two pairs of large feet being deciduous maxillipeds), the thorax not being yet differentiated; and a five-to-seven-jointed abdomen. The size of the cephalothorax, as compared with the abdomen, varies greatly in the different forms of zoëæ, some zoëæ strongly resembling Eurypterus in the small cephalothorax. After the first moult five pairs of rudimentary thoracic limbs arise at the hinder portion of the cephalothorax, thus proving our statement that the cephalothorax of Limulus, and consequently the so-called "head" of Eurypterus and Pterygotus, combines a head with a potential thorax, the latter never becoming differentiated in subsequent moults.

In the Trilobites, however, according to the late discovery of Mr. Billings, the thoracic segments bearing jointed feet are developed; though, as shown by Barrande, the larval trilobite is hatched either without any, or with but a single, thoracic segment. Limulus, Eurypterus, Pterygotus, and their allies (Huxley has aptly compared the Eurypteridea to a zoëa), with the Phyllopods, may be considered as virtually zoëæ, or to be more precise, (since they lack many important characters of zoëæ), retarded or retrograde zoëæ.

Speculating on the ancestry of the members of the subclass * of Branchiopoda, he would trace them all to a common Nauplius form, as Haeckel, Fritz Müller, and Dohrn had done. This Nauplius form may have existed in the Laurentian Period, as we already find highly organized Trilobites, Phyllopods, and Ostracodes in the lowest Silurian strata. He

* Though in his communication to the American Association he has spoken of the Branchiopoda as an *order*, of which he regarded the Pœciloptera as a suborder, he thought the term *subclass* preferable, as, with the subclasses Decapoda and Tetradecapoda, etc., they were much more general groups than the orders of Vertebrates as first limited by Linnæus, whose idea of an order we should follow for the sake of uniformity, just as the term *family* should be applied in the sense in which Latreille used it.

suggested that the modern Phyllopods, such as Apus and Branchipus, may have descended perhaps, by two parallel lines of descent from certain Silurian Copepoda and Ostracoda. He accounted for the origin of these forms rather by a process of acceleration and retardation of development as suggested by Messrs. Cope* and Hyatt,† involving a more or less sudden formation of generic forms, than by the theory of Natural Selection, which involves an indefinite number of slight modifications for the production of even a variety, and such a succession of intermediate generic forms as we do not find recent or fossil. He also thought that the study of the facts of Dimorphism and Parthenogenesis, and the mode of production of the more remarkable sexual differences among animals, would throw light on a comprehensive theory of evolution.

THE ANCESTRY OF INSECTS. — Referring to his discovery of Pauropus in this country, and mentioning the six-legged form of the young, and its resemblance to Podura, and comparing it with the Hexapodous young of Julus and the young of certain mites, Dr. Packard, at the same meeting, referred the ancestry of the Myriapods, Arachnids, and Hexapodous Insects to a Leptus-like terrestrial animal, bearing a vague resemblance to the Nauplius form among Crustacea, inasmuch as the body is not differentiated into a head, thorax or abdomen, and there are three pairs of temporary appendages. Like Nauplius, which was first supposed to be an adult Entomostracan, the larval form of Trombidium, had been described as a genus of mites under the name of Leptus (also Ocypete and Astoma) and was supposed to be adult.

For this primitive, ancestral form he proposed the term Leptus. He suggested that the ancient Leptus may have descended through Demodex from some Tardigrades, and that this latter group had perhaps descended through some form like Linguatula, from a true terrestial worm, like the remarkable Peripatus, for example. The Myriapods may, through a parallel line of descent, have been evolved from some Leptiform animal like the young of Pauropus, while the Hexapoda may have descended by a parallel line of descent through some Leptiform Silurian insect resembling the young of Stylops, Meloe, and low neuropterous or orthopterous larvæ, and the Thysanura, such as Podura and Lipura. He did not regard the insects as having been evolved either from a zoëa or Nauplius form, but would refer the ancestry of both classes (the Insects and Crustacea), independently of each other, to the worms (Annulata).

MONTEREY IN THE DRY SEASON. — On returning to the coast from the Colorado valley in May, 1861, my health impaired by the tropical heat of the last two months at Fort Mojave, and by the too sudden change to the foggy climate of the coast, I was glad of the opportunity of recruiting it by some weeks devoted to collecting marine animals, etc., at Monterey.

* Origin of Genera. Philadelphia. 1868.

† Parallelism between the order and individual in the Tetrabranchiate Cephalopods. Memoirs of the Boston Society of Natural History, 1866, and AMERICAN NATURALIST, Vol. 4, pp. 230 and 419.

Leaving, therefore, my military companions at San Diego, I travelled to San Francisco by land, picking up about forty species of Mollusca at points along the southern coast.

My preparations for dredging, determining my collections, and describing the new vertebrates detained me in San Francisco until August 9th, when I went to Monterey by steamer. There I remained until September 26th, dredging, and collecting along shore chiefly Mollusca, but not neglecting other animals. The additional species collected were thirty-two of Vertebrata, one hundred and seventy-five Mollusca (thirty new species) twenty-seven Radiata and twenty-six Articulata (marine, as I kept no account of the land species constantly preserved). As I have written a very full report of the Mollusca collected, for the American Journal of Conchology, and as most of the other invertebrates have never been determined, because they were lost in the ill-fated steamer "Golden Gate," together with a large collection from the southward, made previous to June, 1862, I can give little that is new or interesting relating to my Monterey collections. The season was the worst for collecting birds, they being in moult; mammals were difficult to obtain and the fishes were chiefly those common in the San Francisco market. Though many whales were killed during my visit, chiefly the "California Gray" (*Rachianectes glaucus* Cope), it was impossible to obtain measurements and drawings of them as they were always cut up while floating, and the mutilated carcasses when washed ashore were deprived of "flukes" and other essential parts, besides smelling so strong that the odor for miles was almost unbearable.

The land mammalia were chiefly very distinct from those of Fort Mojave, as is naturally to be expected in comparing a well-wooded, fertile region with an almost barren desert. The Grizzly Bear was quite common, though I saw only its tracks. Several others of the large forest quadrupeds, well known as Californian, are doubtless to be obtained by longer and more thorough search than I could make. I got two small rodents, the representatives of species to be found at Fort Mojave, viz: the California Wood-rat (*Neotoma fuscipes*), and Wood-mouse (*Hesperomys Californicus*), also one of a genus not found there, the Monterey Field-mouse (*Arvicola edax*).

The most characteristic land birds were the Vulture (*Cathartes Californianus*), the Pigmy Nuthatch (*Sitta pigmæa*), western variety of the Yellow-bellied Fly-catcher (*Empidonax flaviventris* var. *difficilis*), Least Titmouse (*Psaltriparus minimus*). Yellow-billed Magpie (*Pica Nuttallii*), Western Crow (*Corvus caurinus*), White-tailed Hawk (*Elanus leucurus*) besides many representatives of species found in the Colorado valley, such as the Quail (*L. Californicus*), Bowbill Thrush (*H. redivivus*), Anna Humming-bird (*Althis Anna*), Heermann's Song Sparrow (*M. Heermanni*), Californian and Brown Finches (*Pipilo megalonyx* and *fuscus*), while a few seen there only in winter or spring were here breeding, viz: the Black Pewee (*Sayornis nigricans*) Dwarf Thrush (*Turdus nanus*), West-

ern Bluebird (*Sialia Mexicana*), Barn and Cliff Swallows (*Hirundo horreorum* and *lunifrons*), Bewick's Wren (*Thriothorus Bewickii*), Parkmann's Wren (*Troglodytes Parkmanni*), Oregon Snow-bird (*Junco Oregonus*), Chippy (*Spizella socialis*), while a longer residence would no doubt largely increase all these lists. I must however remark that all these, except the second, fifth, and twenty-first, are also summer residents as far south as San Diego, and the three exceptions are probably so in the high mountains east of there. This shows the remarkable uniformity of the fauna, corresponding to that of climate, in zones running parallel to this coast for distances of over five hundred miles.

Of water-birds I observed a few of interest. The whale fishery attracted several species usually seen only far off shore, of which the enormous Petrel or "Gong" (*Ossifraga gigantea*), could often be seen swimming lazily near the try-works to pick up scraps of blubber, sometimes accompanied by the dusky young of the Short-tailed Albatross (*Diomedea brachyura*). The Pacific Fulmars (*F. pacificus*), called by the whalers "Tager" or "Haglet," were common off shore, feeding also on whale meat, but oftener observed chasing the Gulls to make them disgorge. The Murres (*Lomvia Californica*), and Sea Doves (*Brachyzaurphus marmoratus?*), in the open bay seemed strange at this season, but probably both breed near by. On Sept. 10th, I observed many young Phalaropas (*P. hyperboreus?*) about the brackish lagoons near the beach, and a few of the Wandering Tatler (*Heteroseclus brevipes*), as usual among rocks along shore. On the 12th, saw small Grebes (*Podiceps Californicus*), probably lately come from their breeding station; and by the 18th, families of about five each, became common. On the 25th, I first noticed the large Grebe (*P. occidentalis*), but as I left next day I saw no more of the arrival of winter visitors. I need not here particularize the common Sandpipers, Gulls, Terns, Plovers, etc., as I did not preserve any of them, and will have more to say about them when describing my winter collections made at San Diego.

Reptiles are not common at Monterey, on account of the coolness of the summer climate, fogs obscuring the sun for at least half the summer. I found but two species, the large Ridge-back Lizard (*Gerrhonotus multicarinatus*), and a *Plestiodon*, both common in woods from here northward. Batrachia however are well suited by the damp climate, as besides Frogs (*Rana* sp. and *Hyla regilla*), and Toads (*Bufo halophila?*), I found a Salamander (*Batrachoseps attenuatus*) even at this extreme of the dry season, not uncommon.

I will not specify the thirty species of fishes obtained, as most of them have no peculiar English names and the list would be of little interest to general readers. — J. G. Cooper.

The Rough-billed Pelican on Lake Huron. — On the evening of the 15th of June, 1870, a most remarkable specimen of the rough-billed pelican (*Pelecanus erythrorhynchus* Gmelin) was shot by Captain Oliver Maisonville in the marsh at Sarnia, Lambton County, Ontario (Canada).

This bird is very rare on the great lakes, and the individual in question, which was of the male sex, was of unusually large size. It weighed thirty-three pounds, and the expanded wings measured in full one hundred and eight inches! The bill from the eye was sixteen inches in length, being of a dirty yellow or yellowish brown. The plumage was almost pure white, with the exception of the alula, primary coverts, and primaries, which were black, as usual. The long feathers on the breast and those of the crest were of a very pale yellow tint. I also noticed, what I have seen no mention of in the description of this species, that over each eye was a group of small feathers of a brownish black color, and of more than an inch in length, almost simulating an eyebrow; a few feathers of a similar or lighter hue being scattered towards the back of the head. The plumage exhibited nothing of the roseate tinge which this species is described as having at the season of reproduction.

In Baird, Cassin, and Lawrence's "Birds of North America," this pelican is mentioned as breeding "in the fur countries, generally selecting inaccessible places in the neighborhood of water falls;" and as being found "throughout the United States, rare on the coasts of the Northern and Middle States;" and as also inhabiting "throughout the Rocky Mountains and California." The same work gives the stretch of wings as seventy inches, and length of bill 13.50, while much smaller specimens are recorded. Mr. James Hobson, who mounted our specimen, and who is of much experience in this direction, having received several of this species from Florida and elsewhere, says he never before saw so large a pelican; all others he had seen being insignificant in comparison. During a residence of over twenty years in the region of the great lakes, I had not previously met with the pelican, nor had I heard of more than three instances of its having been captured within their limits.

The marsh at Sarnia is an inlet or overflow of the river St. Clair, near its head, and about one mile from the south shore of Lake Huron. The pelican was feeding in the marsh, and had been there two days, having arrived on the evening of the 13th of June. When first seen it was flying from the northward, from the direction of the lake. On the morning of the 14th it flew back to Lake Huron, but returned in the evening of the same day, remaining till shot on the following evening, as before stated. It was very active, wandering over the marsh all day, swimming about, or only rising for a short flight, and alighting again in the water. Strange to say there were no fish found in its pouch; only a few small worms and insects. — HENRY GILLMAN, *Detroit, Michigan.*

MIGRATION OF HAWKS. — Do hawks migrate in pairs only, or do they migrate in flocks and separate into pairs as they arrive at their breeding places? In 1856 my attention was called to quite a number of hawks that were diving, and screaming, and going through various gyrations high in the air (as they commonly do in the spring when pairing) and passing to the north-east. Not making any note of the occurrence I cannot give the exact number or date. It was early in the spring, and there must have

been twenty or more. Early in April, 1860, I witnessed a similar migration when the number in sight at one time was about fifty. A friend of mine in an adjoining town, who is a very careful and accurate observer. asked me a short time since if I ever saw a flock of hawks? He said that early this spring (1870), about the last of March or the first of April when passing over his farm with his two sons, his attention was attracted by the screaming of hawks, and on looking up the air seemed to be filled with them. They attempted to count them, but found it somewhat difficult to be perfectly accurate, as the birds were constantly in motion, diving and screaming and passing northward, yet they counted seventy-three in sight at one time. In both of the flights which I witnessed, and also in that seen by Mr. S. and his sons, the hawks were not in flocks according to the common acceptation of the word flock, but were in pairs, or groups of about four usually, all passing in the same direction, northward. Having never read in our works on natural history, of such numbers passing at one time, I give these facts, hoping to call the attention of our ornithologists to them, and draw out from them any observations which they have made on the subject. — WM. WOOD, M.D., *East Windsor Hill, Connecticut.*

SCUDDER'S WORK ON NEW ENGLAND BUTTERFLIES. — Illness in my family has thus far prevented my completing the work on New England Butterflies announced some time since in these columns. This delay has, however, enabled me to extend the original plan of the book much more fully than was anticipated.

I gladly take this opportunity of thanking my many friends and correspondents for the cordiality with which they have seconded my undertaking, in furnishing me with innumerable notes upon the times of appearance and prevalence of different butterflies in their respective localities. When it is known that such memoranda have already been received from ninety different persons, covering a period of observation of from one to ten years, and, in the case of some butterflies, including as many as one hundred and fifty or two hundred notes for a single species, it is not too much to say that we shall arrive at a degree of exactitude upon the history, seasons, and geographical distribution of our butterflies, which we have not hitherto enjoyed.

In the hope of gaining still further knowledge on these points, I should be pleased to receive notes made by any observers during the season of 1870; descriptions of habits, modes of flight and of posture would be most welcome; and since the result of inquiries has proved the necessity of incorporating in a work on the butterflies of New England and vicinity many forms not mentioned in previous lists of New England species, I beg all persons interested to send me the fullest possible notes, as well as examples of the early stages of the following species (most of these have seldom or never been known to occur in New England; where the names are italicized, specimens of the imago are desired for examination): Papilio Marcellus, *Pieris Virginiensis*, *P. vernalis*, Callidryas Eubule,

Colias Labradorensis, *C. Keewaydin*, C. Eurytheme, Terias Lisa, Xanthidium Nicippe, Anthocaris Genutia, *Nymphidium dorsale*, Lycæna violacea, L. Pembina, L. Scudderii, *Thecla Ontario*, *T. Clothilde*, *Euptoieta Claudia*, *Melitæa Batesii*, *Apatura Clyton*, *Grapta Dryas*, G. Fabricii, G. interrogationis, *Libythea Bachmanii*, *Satyrus areolatus*, Chionobas Jutta, Nisoniades Lucilius, *N. Horatius*, *N. Virgilius*, N. Martialis, N. Icelus, *Eudamus Bathyllus* (not Pylades) *E. Olynthus*, Hesperia Oileus, H. Wingina, H. vialis, H. Monoco, H. Hianna, *H. Mesapano*, H. Delaware, H. Phylæus, *H. Wyandot*, and *H. Huron*.

Persons possessing from their collections and memoranda any precise data, however meagre, for determining the respective times of appearance of the different species of Grapta and Nisoniades, as recently distinguished in the Transactions of the American Entomological Society and the Proceedings of the Boston Society of Natural History, will confer a special favor, by communicating them; many of those already received have lost much of their value from the confusion of the species. Due credit will be given in every instance.

Letters, memoranda and specimens, sent to my address at the *Society of Natural History, Berkeley Street, Boston*, before March 4th, 1871, will be forwarded thence to me in season for incorporation in my book. The manuscript will soon be completed. It will form an imperial octavo of from four to five hundred pages, and be illustrated by chromolithographic plates in a style which, judging from specimens prepared, has never yet been equalled, even in Europe. — SAMUEL H. SCUDDER.

CALLIDRYAS EUBULE Linn. — This large Pierian butterfly was taken by me at New Bedford, Mass., Aug., 31st. Mr. Sanborn, who has seen the specimen, speaks of it as the first one of the kind observed in New England, or at least in Massachusetts. H. W. PARKER.

[Mr. S. I. Smith informs us that he has taken this insect abundantly at Fire Island, Long Island, N. Y., during the past summer.] — EDS.

MEPHITIS BICOLOR. — Since my note in the August NATURALIST was written, on the occurrence of this species in Iowa, I have obtained another skin in Grinnell, Iowa, and still another in Des Moines, from a dealer in pelts, who informs me that he bought at least fifty skins of the kind last winter, procured in that vicinity. There is reason to believe that the species may be found even in central New York. Dr. S. J. Parker, of Ithaca, N. Y., has twice seen by the roadside, in that region, a small, many-striped skunk, very different from the common one.—H. W. PARKER.

WOODCOCK AND MOLES. — The Shrew Mole (*Scalops Canadensis*) has been somewhat abundant for a few years past in Essex county, Massachusetts. These animals are found in low moist lands, though not unfrequently in highly cultivated gardens. The shrew mole is seldom seen above ground, but burrows with celerity below its surface.

The Star-nosed Mole frequents the same moist places, where, like the

shrew mole, it finds its favorite food, such as earth-worms, grubs, etc. In procuring its food it makes extensive and numerous burrows, above which mounds of loose dirt are thrown to the surface of the land, which destroy the smooth and even surface of the meadow and make it look unsightly and difficult to cultivate.

Now there is a beautiful bird designed by nature to prevent the increase of these noxious animals from becoming excessive in places frequented by the mole. It is the woodcock (*Scolopax minor*), whose death is delayed until the 15th of August by a law of the State, after which time there will probably be a general attack made upon them with the gun.

It is observable what a difference there is in the appearance, in some localities, occupied by the above mentioned animals. A friend told me a few days since that it was difficult to mow a piece of his land last year on account of the many piles of earth thrown up by the moles. This year the surface of his land is smooth, and I have passed several times this summer by the place and have frequently heard, or flushed the woodcock feeding there in the dusk of evening. — AUGUSTUS FOWLER, *Danvers, August* 14, 1870.

TURKEY BUZZARD. — On page 375, current volume, J. L. B., in a paragraph on this bird, inquires "Can a Turkey Buzzard be deceived by his sense of smell? Did the Buzzard mistake the skunks' smell for putrefaction?" Two propositions are here answered as undeniable. First, that the Turkey Buzzard selects its food by the sense of smell; and second, that it prefers putrefied food. It seems to me that the exhaustive experiments by Mr. Audubon and Dr. Bachman, made nearly forty years since, as related by the former in his "Ornithological Biography," Vol. ii, page 33, should settle these questions. I think, then, that it may be safely assumed that both the Turkey Buzzard (*Cathartes aura*) and the Black Vulture (*Cathartes Jova*) are practically incapable of distinguishing odors, and select their food by the sense of sight alone; and also that they feed upon fresh, as readily as upon putrid, flesh. As the old error on this subject seems to be perpetuated no doubt to a considerable extent, and as that great work is rare, at least in private libraries, might not the whole, or at least a part of the paper to which I have referred, prove interesting to your readers? — J. D. CATON, *Ottawa, Illinois, Aug.* 22, 1870.

SPIKE HORNED BUCKS. — Mr. H. H. Bromley, proprietor of the Chasm House near Keeseville, has given me an account of the *spike horns* that is confirmatory of "Adirondack's" statements, and also shows that the variety extends farther south in the Adirondack region than heretofore stated.

Mr. Bromley was for six years the landlord of the Hotel at Franklin Falls, located on the Saranac River, about thirty miles southeast of Lewis Lake and the region mentioned by "Adirondack." When he first went into this region, eight years ago, he was told about the spike horned bucks which were then *common* and well known to all the hunters and trappers in the Saranac region. During his residence at Franklin Falls,

he shot several spike horns, and one at least was a large buck of *four years* if not of five, and was so considered by several old hunters. In this specimen one of the horns was slightly forked at the end, but the other was a simple slightly curved spike. Mr. Bromley says that any old hunter of the Saranac region would laugh at the idea of all the spike horns being young bucks of two or three years, and he states that they can be recognized by their *shorter legs*, as well as by their spike horns.

Mr. Bromley thinks that the spike horns have increased in numbers over the branched horns, and that in spite of the extensive hunting are about as abundant as when he first went into the woods. — F. W. P.

Deer's Horns. — It is a well known fact that the horns of deer are but very seldom found in the woods, even in districts where the deer are very plenty. Several ways of accounting for their disappearance have been suggested, but the cause that seems to be the best substantiated is that of their being eaten by the various species of rodents seeking their food under the snow in early spring. In confirmation of this theory Mr. H. H. Bromley of Keeseville, N. Y., has informed me that he once found a deer's horn in the woods that had been partly gnawed, and had been nearly eaten through in two places by mice. — F. W. P.

Singular Manners and Customs of the Hornbills during the Breeding Season. — No sooner has the hen commenced the labor of incubation, say several trustworthy observers on this subject, than the male walls up the hole in the hollow tree in which the hen is sitting on her eggs, until there is only room for the point of her bill to protrude, so that until her young birds are hatched she remains confined to her nest, and is in the meantime assiduously fed by her mate, who devotes himself entirely to this object. This habit has been testified to not only by Tickell, Layard, and other Indian naturalists concerning some of the Asiatic species, but is also spoken of by Dr. Livingstone in the case of hornbills met with during his African explorations, and there appears to be no doubt of its authenticity. In Sumatra, in 1862, Mr. Wallace heard the same story from his hunters, and was taken to see a nest of the concave-casqued hornbill, in which, after the male bird had been shot while in the act of feeding its mate, the female was discovered walled up. "With great difficulty," Mr. Wallace tells us, "I persuaded some natives to climb up the tree, and bring me the bird. This they did, alive, and along with it a young one, apparently not many days old, and a most remarkable object. It was about the size of a half-grown duckling, but so flabby and semi-transparent as to resemble a bladder of jelly, furnished with head, legs, and rudimentary wings, but with not a sign of a feather, except a few lines of points indicating where they would come." — *Nature.*

GEOLOGY.

The Megatherium and its Allies. — The law of adherence to type, or pattern, in the skeletons of the Megatherium, Megalonyx and Mylodon, extinct animals of the sloth tribe, appears to be illustrated in a remarkable manner in the following particulars: —

First. — In the great size, weight and solid condition of the bones of the extremities and in their want of medullary cavities.

Second. — In the number, arrangement, $\frac{5-5}{4-4}$, mode and unlimited growth of their teeth; in their deep insertion into the jaws; their deeply excavated base; in the structure of their teeth, when viewed as organs, — made up of a cylinder of vascular dentine, dentine and cementum, and more particularly in the striking resemblance of their organization when examined under the microscope; that of the Megatherium and Mylodon being precisely the same, with the exception of the looped canals or tubules in the cementum, as figured by Prof. Owen in the article Odontography, in the "Encyclopædia Britannica."

Third. — The bones of the skull resemble each other strongly in the great development of the cells of the diploë, which in their general appearance resemble wood eaten through and through by the largest sized worms; and in the shortness of the face. The alveoli of the two jaws correspond in number, position and relative depth, with the exception of Megalonyx, which has its first molar in the upper and lower jaw separated from the other teeth and taking the usual place of the canine or cuspidate teeth.

Fourth. — The bones of the chest and trunk have, in general, a strong resemblance in size and form, especially the ribs in size, the scapula in form, the expanded ilia, and the clavicles. The bones of the hand and arm have a marked family likeness — the radius and ulna of Megathere and Megalonyx, the humerus of Megalonyx and Mylodon in particular, and in all the genera in the broad expansion of the external and internal condyles of the humerus for the origin of the supinator and pronator muscles. The differences between these in outline and form from that of Megatherium will be hereafter alluded to.

Fifth. — The number and size of the bones in the tail of Megatherium and Mylodon, and the use to which this appendage is put, appear to be precisely the same, making with the posterior extremities a most stable tripod for the support of these animals while reaching for their food.

Sixth. — In the broad and massive femur of the Megatherium and Megalonyx there is a marked resemblance: as figured in Leidy's "Memoir" and in the "Penny Cyclopedia" and "Encyclopædia Britannica," this bone in the Mylodon appears not to be so flattened in front, but this appearance may be only the result of foreshortening in the drawing; judging from a fragment in my possession it does not differ much from the femur in Megathere or Megalonyx. The tibia of Megalonyx bears considerable resemblance in form to that of Mylodon, but it is not united in either of these animals (making as it were one bone) as in Megatherium.

The bones of these extinct animals differ somewhat: —

First. — In the general outline of the lower jaw of Megatherium, especially that of Meg. Cuvieri from South America; less so, however, in that part where the teeth are implanted in the N. American Megathere, and in its anterior prolongation.

Second. — The skulls of Megalonyx and Mylodon, looking at them either from above or below, differ somewhat, especially in their width;

this difference, however, may be the result simply of the displacement forwards of the first molar, as appears to be the case with some varieties of dogs.

Third. — The humerus of the Megatherium differs from that of Megalonyx and Mylodon chiefly in that part from which the *brachialis anticus* muscle arises. The bone in Megathere at this point, viz., on either side of the insertion of the deltoid, being broad and flat, while, in Megalonyx and Mylodon especially it forms, with a marked prominence on the outside of the bone, a large hollow surface looking outward and backward, for the origin of the external part of the muscle, and which large and deep groove seems to have been filled up by it. The distal extremity of the humerus of Megalonyx is pierced by a large but short oval canal for the passage of the median nerve and brachial artery, which canal is not to be seen in the humerus of the Megatherium or Mylodon, although there is in the humerus of the latter a groove near this spot along which, in all probability the nerve and artery passed in their course to the forearm.

Fourth. — The astragalus of the Megalonyx, Dr. Leidy says "bears much more resemblance to that of the recent, than to any of the extinct sloths. That of the Megatherium is the most characteristic bone in the skeleton: the upper surface being so hollowed on one side, as to throw the whole weight of the leg upon the inner side of the foot."

Fifth. — The cubitus of Mylodon, as figured by Dr. Harlan, very slightly resembles either that of Megathere or Megalonyx.

From the few facts above stated, it would be unwise to draw hasty conclusions, and if the three genera have a common parentage it would be difficult to say to which genus the first pair belonged. Are there not, however, as strongly marked resemblances between the skeletons of the different members of this extinct tribe of animals as are to be found in Hipparion, Anchitherium and Equus, which have been brought forward by Professor Huxley in confirmation of Mr. Darwin's hypothesis?

The marked resemblance between the skeletons of the Megatherium and Mylodon as set up in the Museum of the Royal College of Surgeons, London, and in the Museum of the Boston Society of Natural History, must be acknowledged by all who have seen the skeletons, or the figures of them under the articles Unanu, "Penny Cyclopedia," Palæontology, "Encyclopædia Britannica," and the beautiful photograph by Mr. Allen of Boston.

No less marked will appear the mechanism of the elbow joint in all the genera of these digging animals, and the upper or mashing surface of their teeth, so characteristic of all the Megatheroid tribe — the surface presenting at one time "a transverse sulcate plane, at another, excavated in the midst, with prominent margins." — H. C. PERKINS, M.D.

THE TERTIARY BEDS OF THE AMAZON. — Up to December, 1867, no fossils had been observed in the peculiar variegated clay formation which overspreads the great valley of the Amazon. At that time I was sojourning with my friend Hauxwell at Pebas, where I discovered a multitude of

fossil shells exposed in the fine section made by the Ambiyacu just before it reaches the Marañon. These shells were examined by Gabb, who showed that they existed in brackish water of Tertiary date; but he made the mistake of identifying the Neritina as *N. pupa*, which is now living. Conrad shows it is an extinct species. I then engaged Mr. Hauxwell to explore for other localities, being sure they would be found. He soon reported a similar deposit thirty miles below Pebas on the south side of the Marañon, about one hundred and twenty miles west of Tabatinga, where he found the very same species occurring at Pebas, and many more, and larger kinds. Out of half a bushel of specimens which he sent me, this is the result arrived at by our eminent palæontologist, Mr. Conrad. Not one species was found in the whole collection which is now living; indicating an early tertiary date. There were seventeen distinct species, *all extinct*, belonging to genera only three of which are now represented. The most numerous species seems to be the *Anisothyris* (*Pachydon*) *obliquus*. In the whole collection there is but one land shell (Bulimus), and but one decidedly fresh-water species (Hemisinus). The great majority belong to a genus which was especially abundant in the early Tertiary, and lived in brackish water. This agrees perfectly with my theory of the origin of the Amazon Valley; at first a Mediterranean sea separated from the Caribbean and South Atlantic by the rise of the water-sheds which created the Orinoco and Paraguay, it was gradually freshened by the influx of the fresh-water streams from the surrounding highlands, and gradually emptied into the Atlantic by the continued rise of the Andes. The fossils were found in the heart of the valley interstratified with the colored laminated clays which I had traced from Curary on the Rio Napo down to the Lower Amazon, and which Agassiz affirms is a glacial deposit brought down from the Andes and worked over by a vast glacier moving over the whole plain. This is mere assertion, for he found not one positive evidence. Besides, there are strong biological and physical arguments against the theory of tropical glaciers. My fossils are wonderfully perfect, even the most minute and delicate ones, and none show the least abrasion; a glacier would have ground them to powder. Conrad says they must have lived and died in the vicinity of the spot where they now occur so abundantly.—James Orton, *Nov.* 15, 1870.

Lead Mines of Missouri. — Mr. G. C. Broadhead read a paper before the St. Louis Academy of Science in October, entitled "Notes on the Geology of Cole County, Missouri." He mentions that the Magnesian limestone series, which include the rich mineral deposits of Missouri, occur in Cole County, and that the rich Galena lead mines are in the lower beds of the second Magnesian limestone. At Fowler's mines he noticed lead, zinc, and heavy spar; the latter in very clear amber-colored crystals and in blue lamellar forms.

Marks of Ancient Glaciers on the Pacific Coast. — Dr. Robert Brown dissents from the theory of an entire absence of glacial remains proper on the Pacific slope of the Rocky Mountains, stating that the

northern drift is present in Vancouver Island and British Columbia, "in as marked a manner as ever I saw it in countries celebrated for the presence of such remains."

He finds rounded hills, trap bosses, rounded rocks, and grooves, while the whole country is strewn with erratic boulders. Great masses, sixty to one hundred tons in weight, are found scattered everywhere over the island (Vancouver) from north to south, and through the region lying on the western slope of the Cascade Mountains. "Grooving and other unequivocal marks of *general* ice action are not wanting in Washington Territory either. The drift marks extend northward to the Queen Charlotte Islands, near the boundary line of Alaska. — *American Journal of Science.*

Boulders in Ancient Times. — In a communication made to the Academy of Sciences of Vienna, M. Boué remarked on the accumulations of boulders in secondary deposits and in the sandstones and conglomerates of the tertiary period. These accumulations have been explained either by the mining force of the currents of water, or by subterranean displacements, or by aqueous eruptions. The most ancient of these blocks are found in the older carboniferous sandstone. They have been traced between Jurassic and Cretaceous beds, and in the latter; but nowhere do they more frequently occur than in the Eocene and Miocene beds of the Alpes. These last have been very probably transported by glaciers, though he could not admit, as some geologists have, that the glaciers have hollowed out the basins of the lakes, or had existed in the course of almost all geological periods. — *Cosmos.*

New Discovery respecting Coccoliths. — Dr. Gümbel, of Munich, has recently, in a letter to *Nature*, No. 26, for April 28th, established the existence of coccoliths and coccospheres, almost identical in structure with those detected by Professor Huxley, in recent deep-sea dredgings from the bed of the Atlantic, in the Trenton limestone and in a yellow limestone of the Potsdam series, much lower down than they have hitherto been discovered. He finds that the organic remains of these minute animals are left as a residuum after the matrix in which they occur has been heated with highly-diluted acetic or hydrochloric acid.

NOTES.

The Yale College scientific party, in charge of Professor O. C. Marsh, which left New Haven in June last for the Rocky Mountains, returned to this city on the 18th of December. The party, which was essentially a private one, consisted of Professor Marsh and twelve companions, all students or recent graduates of the College. The main object of the ex-

pedition was to investigate the extinct vertebrate fauna of the Tertiary and Cretaceous deposits of the Rocky Mountain country, and the general plan adopted was to make several separate trips, of one or two hundred miles north or south of the Pacific railroad, to regions that were unexplored, or had never been carefully examined.

The first of these was made early in July, from Fort McPherson in Nebraska to explore the Pliocene deposits along the Loup Fork river. Here rich collections of fossil vertebrates were obtained, and several new species of extinct mammals and birds discovered. The next expedition was made in August, from Fort D. A. Russell in Wyoming, to examine the geology of the country between the north and south branches of the Platte river. On this trip the Mauvaises Terres or "Bad land" formation, with the true *Titanotherium* and *Oredon* beds was discovered in Colorado, and traced northward through Nebraska to the North Platte. The fossil remains obtained were also important, and included several species of extinct mammals and birds, new to science.

The third expedition was made from Fort Bridger, Wyoming, in September and October, to examine the geology of the Eastern Uintah Mountains, and the country between the Green and White rivers. In this region interesting geological discoveries were made, and many new Tertiary vertebrate remains secured, which will soon be described by Professor Marsh. On their return, the party went to California, and spent a month in visiting various points of scientific interest; after which they came east to Denver, and thence to Fort Wallace, Kansas. About two weeks were spent in exploring the Cretaceous beds of this vicinity, where some interesting reptilian and fish remains were obtained, and the party then returned to the east.

The expedition as a whole was very successful, and the large collections made will be placed in the Peabody Museum of Yale College. The more important scientific results will soon be published.

Capt. Wheeler, who explored in Nevada last year, has an expedition probably started or about to start. Mr. H. A. Green, late of the Illinois Geological Survey, is Geologist and Mineralogist. Ferdinand Bischoff, who was an indefatigable member of the Scientific Corps of the Western Union Telegraph Expedition, is to make the zoological collections. Capt. Wheeler is to ascend the Colorado Cañon from below with a steamer. His party will have abundant facilities for transportation, and the Commander is much interested in the scientific part of the work. Mr. Powell got an appropriation of $12,000 to make a second descent of the Cañon of the Colorado, and will do so some time this winter. He has already been on to that part of the country, and arranged his details. Altogether the Cañon is in a fair way of being thoroughly explored.

The French *Académie des Sciences* has held its sittings regularly since the beginning of the siege, and the *Comptes rendus* has been published regularly every week. — *Nature.*

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